

To: Jackson, Ryan[jackson.ryan@epa.gov]; Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]
Cc: Clare Schulzki[Cschulzki@ajw-inc.com]; Haley Armstrong[harmstrong@icac.com]
From: Chris Hessler
Sent: Tue 8/29/2017 3:10:51 PM
Subject: FW: ICAC Issue Briefs
[170811 EPA issue brief cover letter.pdf](#)
[170817 International Issue Brief FINAL.pdf](#)
[170817 DCPD EMD issue brief FINAL.pdf](#)
[170817 CEMD Issue Brief FINAL.pdf](#)

Resending – I used a bad address for Mandy when I sent this yesterday.

Apologies.

Hessler

From: Chris Hessler
Sent: Monday, August 28, 2017 5:28 PM
To: jackson.ryan@epa.gov; 'gunasekera.mandy@epa.gov' <gunasekera.mandy@epa.gov>
Cc: Clare Schulzki (Cschulzki@ajw-inc.com) <Cschulzki@ajw-inc.com>; Haley Armstrong <harmstrong@icac.com>
Subject: FW: ICAC Issue Briefs

Ryan & Mandy:

Attached please find the issue briefs that the ICAC developed in response to the questions that Administrator Pruitt asked during our May meeting in your offices. We welcome the Administrator's interest in the control manufacturing industry's perspective, and appreciate how busy your whole team is. Accordingly, the key points are summarized in the attached cover letter and in the Executive Summary of each paper.

In particular, I would draw your attention to the discussion about ozone monitoring and the potential for increased exports of technologies developed and manufactured in the US.

We would welcome the opportunity for a brief call or meeting to discuss what – if any – follow up actions might be of mutual interest to the EPA and the ICAC.

Hopefully you each got a little down time this summer. It looks to be a busy Fall for all of us.

Thanks again.

Hessler



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@AjwHessler

Enhancing market opportunities for innovative technologies.

From: Haley Armstrong

Sent: Wednesday, August 23, 2017 3:48 PM

To: Chris Hessler <CHessler@ajw-inc.com>

Cc: Michael Goo <mgoo@ajw-inc.com>; Clare Schulzki <Cschulzki@ajw-inc.com>

Subject: ICAC Issue Briefs

Hi Chris,

Here is the final package of ICAC issue briefs with the cover letter to email to Ryan and Mandy at EPA.

Thanks,

Haley

Haley Armstrong
Institute of Clean Air Companies
2200 Wilson Blvd, Suite 310

Arlington, VA 22201

202.478.6188 (office)



August 23, 2017

Honorable E. Scott Pruitt
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, D.C. 20004

Dear Administrator Pruitt:

Once again, on behalf of the Institute of Clean Air Companies (ICAC) leadership and membership, I want to thank you for meeting with ICAC on May 4, 2017. We appreciated the very open and direct discussion you had with us, and your willingness to continue to work with ICAC on key issues of importance to EPA and our membership. During the meeting you raised several important issues and asked for our further input. As promised, we have engaged ICAC's four technical divisions to respond to your requests and developed the attached materials that we hope will prove useful to you and your staff.

In our meeting, you asked us to look into the following issues:

1. **Measurement & Monitoring:** Information on advancements and opportunities in measurement/monitoring and ways to better understand background ozone concentrations,
2. **Global Markets:** Identifying ways in which EPA can support the export of American air pollution control products – such as EPA and Department of Commerce-convened international technology and innovation conference, reverse trade missions, etc.,
3. **Domestic Conventional Pollutants:** Information regarding opportunities to accelerate attainment (technology advancement, increased deployment),
4. **Infrastructure Initiative:** Perspectives regarding technologies and strategies to improve grid resilience and diversity – including the use of solid fuel.

We have prepared three papers addressing these issues: Our Domestic Conventional Pollutants Division, working with our Emissions Measurement Division, prepared a response addressing items 1 and 3. Our International Conventional Pollutants Division has addressed item 2, and our Carbon Emissions Management Division prepared a paper that may be useful in considering ways in which to support continued use of solid fuel, as a means of ensuring diversity (item 4).

A few points to highlight regarding each paper:

Measurement/Monitoring/Domestic Conventional Pollutants Paper

- ICAC members have helped to develop and improve technologies that have allowed the U.S. to substantially reduce air pollution at costs that were lower than predicted, during a period

of sustained GDP increases. The paper details some of these success stories and outlines further opportunities for additional work.

- Measuring and monitoring techniques for ozone and background ozone have been in place for many years, however this area remains complicated. We have included some useful references regarding monitoring and natural background ozone that we hope you will find helpful. In any event, there continues to be a need to monitor and control ozone levels which lead to documented health effects and ICAC members stand ready to assist in this regard.

Global Markets/International Division Paper

- EPA can be essential to ICAC's worldwide success by helping to assess and develop foreign markets for air pollution control equipment. Enhancing access to foreign markets for air pollution equipment can mean billions of dollars of exports for U.S. companies and can help benefit the global environment. EPA, ICAC and the Department of Commerce (DOC) are already working well together on these issues, but there is much more that can be done.
- ICAC, EPA and DOC are exploring high level trade missions, including a reverse trade mission related to coal fired power. We encourage you to participate in and support these efforts. Negotiations, such as the reopening of NAFTA and work on agreements related to environmental goods, provide an important opportunity to level the playing field for U.S. companies in both the trade and environmental areas—we encourage EPA to participate. EPA's Office of International and Tribal Affairs can play an important role in assisting U.S. businesses and DOC in pursuing export opportunities for air pollution control equipment. We encourage you to consider continuing to direct resources toward this office.

Infrastructure Initiative/Carbon Emissions Management Division Paper

- Fossil fuels such as coal must continue to be part of the fuel mix in order to ensure reliability and fuel diversity. Additionally, coal and natural gas combustion will continue to be a key resource for industrial facilities. Carbon management, including capture, utilization, and storage or sequestration (CCUS), can play a key role in the future of fossil fuels, including coal, oil and natural gas. Use of CO₂ for enhanced oil recovery provides an important profit opportunity and way of lowering the costs of carbon management, while helping our domestic oil industry.
- There are numerous ways to support and incentivize carbon management through federal programs that enjoy widespread support in both Congress and in the private sector. EPA can assist in developing and implementing such programs and make development of carbon management systems a key aspect of any infrastructure initiative.
- The United States continues to be the world leader in developing and implementing carbon management technologies and systems. As with other air pollution control technologies, our goal should be to export those innovations to the rest of the world, in ways that level the economic and environmental playing field.

As the national non-profit trade association of companies that supply air pollution control and monitoring systems, equipment, reagents/sorbents and services, ICAC has promoted the air pollution

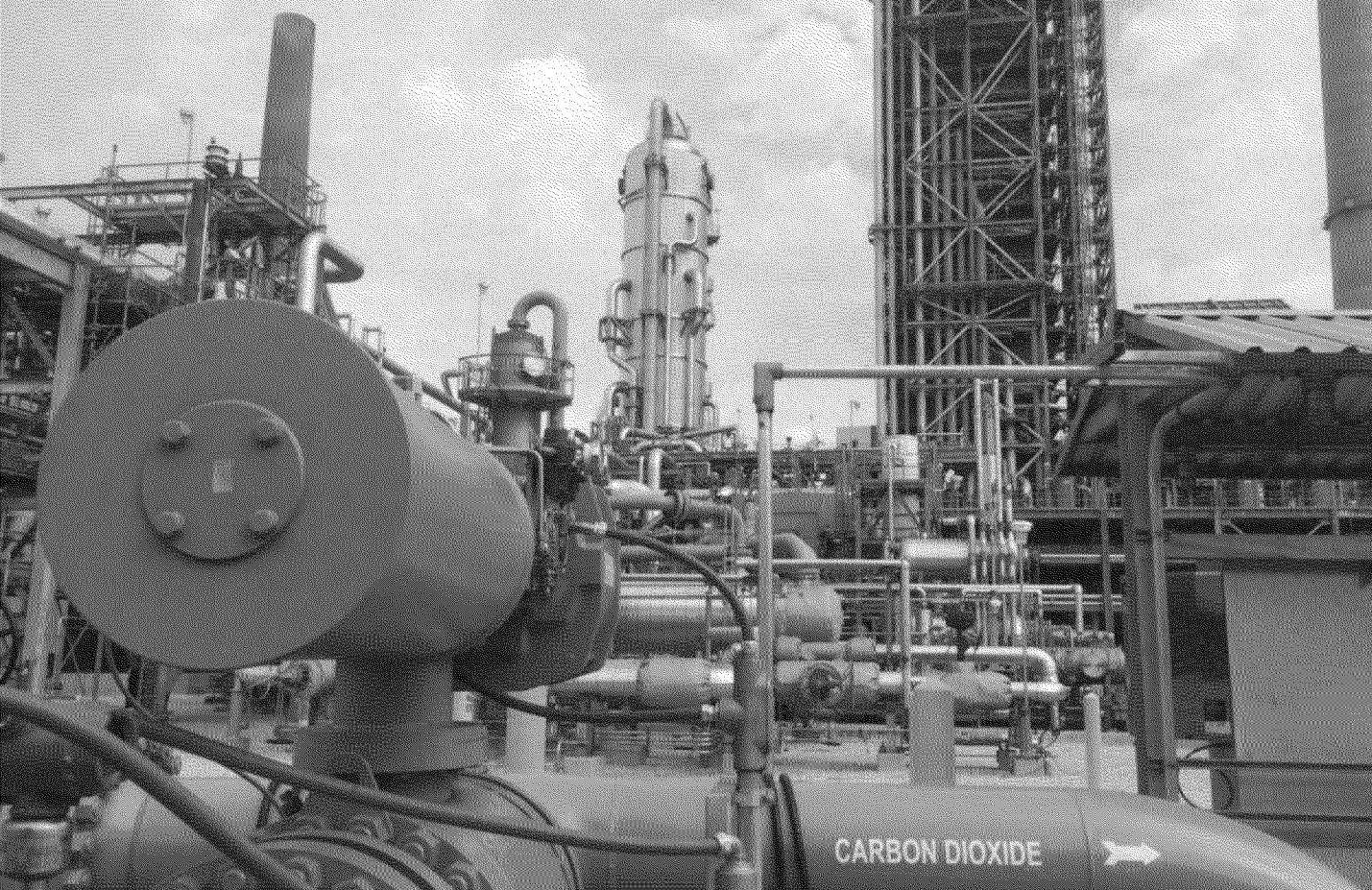
control industry for more than 50 years. Our members include more than 50 leading manufacturers who employ thousands of workers throughout the United States, with billions of dollars per year of revenues. History has shown that EPA has a major role to play in developing stable, cost-effective regulatory programs that help to clean the air at a reasonable cost. Such programs are essential for the business future of all the ICAC members.

Let me thank you again for your time in our meeting and for listening to our views. We look forward to working with you and please do not hesitate to call or contact us for any reason.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael Corvese". The signature is fluid and cursive, with a long horizontal stroke at the end.

Michael Corvese
President
The Institute of Clean Air Companies



THE INSTITUTE OF CLEAN AIR COMPANIES (ICAC)
CARBON EMISSIONS MANAGEMENT DIVISION

Issue Brief for
United States Environmental Protection Agency
Administrator E. Scott Pruitt



EXECUTIVE SUMMARY

Fossil fuels, including coal, will continue to be a critical energy resource, both domestically and globally. ICAC members have been involved in efforts to manage carbon from fossil fuels for decades, as described in more detail below. Further support is needed from the federal government (and other sources) to commercialize and lower the costs of these technologies. There is broad bi-partisan support for devoting additional resources for carbon management. EPA and DOE can play a key role in helping to maintain and expand our progress in the carbon management area, so that ICAC and other U.S. businesses can gain a competitive advantage globally and increase exports of valuable technology. ICAC encourages Administrator Pruitt and the Trump Administration to assist in this effort.

1. INTRODUCTION

Fossil fuels will continue to be needed for the foreseeable future in transportation, power, building heating, and heavy industry, in the U.S. and abroad. However, there is increasing pressure in both the U.S. and other countries for users of fossil energy to manage their carbon emissions. ICAC member companies have been involved for years in efforts to develop and commercialize technology to enable the capture, utilization and storage of carbon emissions (CCUS). ICAC members will continue to be involved in both the development of these technologies and efforts to lower cost and achieve greater profitability, including efforts to improve the economics of enhanced oil recovery (EOR). While there are many promising developments in the CCUS field, CCUS continues to require additional research and development support, both to lower costs of existing, proven technologies and to develop new and innovative technologies. As noted by the Chief Executive Officer of ExxonMobil, Darren Woods:

“Carbon capture and storage technology is another key part. ExxonMobil has an interest in about one-quarter of the world’s CCS capacity. Last year, we announced a technology partnership to research whether fuels cells can be used to capture carbon dioxide more economically. This potential game-changer could enable continued hydrocarbon use with greatly reduced emissions.” -Darren W. Woods at the World Petroleum Congress, July 10th, 2017

In a blog post by Peter Grubnik, the Project Manager for the Global CCS Institute talks about his optimism for the future of CCUS technology.

Read his post [here](#)

ICAC member companies believe that the long-term utilization of fossil resources will be compromised without technologies to limit carbon emissions. Resulting constraints on the utilization of fossil fuels will have significant impact on companies, service providers, and their employees that utilize these critical national resources. Financial incentives for CCUS technology development today will assure that reliable, domestic fossil energy sources are available to power our economy for future generations. The U.S. currently leads the way in development of CCUS technologies, and is a major global producer of fossil fuels, especially coal. EPA and DOE can play a key role in helping to maintain and expand our technological progress in the CCUS area, so that ICAC members can translate that to a U.S. competitive advantage globally.

A variety of interested parties are focused on additional research. Project developers, industrial suppliers of CO₂, technology vendors, ethanol producers, electric utilities, oil and gas producers, coal companies and others are supporting federal financial incentives for CCUS. They support legislation that increases the financial certainty for carbon capture project investors, increases the credit value for EOR and other geologic storage, expands industrial participation in CCUS, and enhances flexibility in utilization of the tax credit to allow multiple business models.

In March of 2017, a group of interested parties that included Peabody Energy, Arch Coal, Cloud Peak Energy and the United Mine Workers of America wrote to President Trump regarding federal investment in fossil energy technologies like CCUS, stating that:

“In light of recent calls for dramatic cuts to the federal government, we want to stress that every dollar allocated to fossil energy research is an investment in the long-term future of America’s coal and fossil fuel industry. And this federal investment yields significant benefits. There are technologies under development...that will improve the performance and costs of fossil fuel technologies, make coal more competitive and enhance our energy security. That includes technology that captures carbon and uses it to increase domestic oil production through a process called enhanced oil recovery.”¹

There are a number of bipartisan bills in Congress that seek to achieve these goals, discussed more fully below. Bills to make CCUS projects eligible for private activity bonds have been proposed in both chambers. Bi-partisan legislation was also introduced in the past two Congresses to allow CCUS facilities to qualify for the Master Limited Partnership structure. Some groups have also requested the President to include several identified carbon capture projects as part of any major infrastructure effort.

Additionally, there is growing state support for CCUS and CO₂-EOR. 16 states participate in the State CO₂-EOR Deployment WorkGroup convened by the Great Plains Institute, which is helping state policy makers better understand states’ potential for CCUS and recommending policies for states and the federal government.

Although some technologies are proven, to further reduce the capital costs and operating costs, implementing new projects requires additional resources and activities that can only be provided with government support. Reductions in capture costs will flow from the research that comes from such projects. In addition, government policy can provide direct incentives (e.g., through R&D spending to fuel further innovation and pilot testing of advanced capture technologies) or incentives through the policy itself.

CCUS technology is proven and in use around the world. Twenty-seven large-scale CCUS projects are in operation or under construction globally of which thirteen are in the United States.

If this continues, the U.S. has the potential to be the world leader in CCUS technologies, which could provide businesses with valuable export opportunities and expand domestic manufacturing jobs. ICAC members can play an important role in helping to grow America’s economy through continued development of CCUS.

¹ “Letter from Top Coal Companies, Labor Unions and Organizations.” Letter to President Trump. 10 Mar. 2017. MS. N.p. <https://www.eenews.net/assets/2017/03/13/document_gw_02.pdf>.

1.1 CCUS BACKGROUND

Several decades of research, development and deployment support the current state of CCUS technologies. Each of the main elements of carbon capture and storage: 1) capture, 2) transport via pipeline and 3) injection into underground formations, have been demonstrated separately by the oil and gas and chemical industry. However, use of these technologies together and at scale in a power context is a process that is still undergoing development. Significantly lower costs and reduced energy use will be required before widespread commercialization can occur.

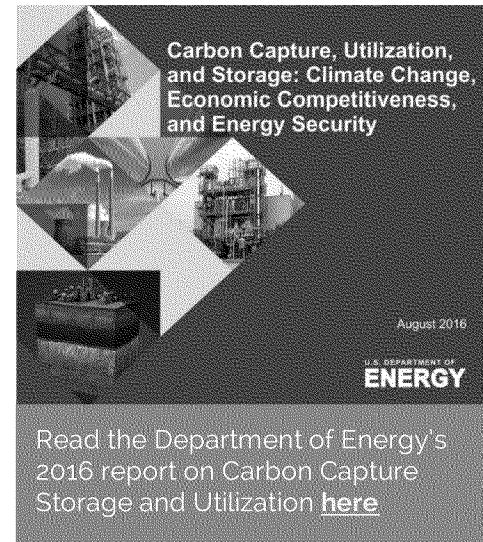


Figure 1. List of US CCUS projects. A complete list of worldwide projects is provided at the conclusion of this paper.

| Name | Location | Operation date | Industry | Capture type | Capture capacity (Mtpa) | Primary storage type |
|--|---------------|----------------|------------------------|-------------------------|-------------------------|------------------------------|
| Terrell Natural Gas Processing Plant (formerly Val Verde Natural Gas Plants) | United States | 1972 | Natural Gas Processing | Industrial Separation | 0.4 - 0.5 | Enhanced oil recovery |
| Enid Fertilizer | United States | 1982 | Fertiliser Production | Industrial Separation | 0.7 | Enhanced oil recovery |
| Shute Creek Gas Processing Plant | United States | 1986 | Natural Gas Processing | Industrial Separation | 7.0 | Enhanced oil recovery |
| Century Plant | United States | 2010 | Natural Gas Processing | Industrial Separation | 8.4 | Enhanced oil recovery |
| Air Products Steam Methane Reformer | United States | 2013 | Hydrogen Production | Industrial Separation | 1.0 | Enhanced oil recovery |
| Coffeyville Gasification Plant | United States | 2013 | Fertiliser Production | Industrial Separation | 1.0 | Enhanced oil recovery |
| Lost Cabin Gas Plant | United States | 2013 | Natural Gas Processing | Industrial Separation | 0.9 | Enhanced oil recovery |
| Illinois Industrial Carbon Capture and Storage | United States | 2017 | Ethanol Production | Industrial Separation | 1.0 | Dedicated Geological Storage |
| Petra Nova Carbon Capture | United States | 2017 | Power Generation | Post-combustion capture | 1.4 | Enhanced oil recovery |

2. CAPTURE

Currently, there are a number of different methods used to separate and capture CO₂ from power plants and industrial facilities. For power plants, technologies can generally be separated into post-combustion and pre-combustion approaches. In post-combustion CO₂ capture, the CO₂ is commonly removed from the flue stream via a chemical solvent (scrubbing). The carbon is absorbed into the solvent to remove it from the exhaust from combustion. Then, the carbon needs only to be separated from the solvent.

A post-combustion system is in use at NRG's Petra Nova facility located outside of Houston, Texas. After receiving a \$190 million grant provided by the federal government and private industry, the Petra Nova plant opened on-time and on-budget, and is the largest post-combustion carbon capture plant in the world.

Pre-combustion takes the CO₂ from the fossil fuels before combustion is completed. In this process, a syngas is created from coal. CO₂ and hydrogen in the syngas are separated after purification. The CO₂ can be sent for EOR or sequestration and the hydrogen can be used as fuel to generate electricity. This process has been used at the Polk plant in Florida for some time. This is also the process that was planned for the Kemper facility in Mississippi, but that plant has been subject to cost overruns and recently announced its intention to convert to a gas plant. The Kemper plant is indicative of the need for further government support into research and development before full commercialization of CCUS technology can be successfully implemented widely.

In EOR, CO₂ is pumped down into existing mature oil fields to the oil-bearing formation and then, usually in conjunction with injected water, it mobilizes the remaining oil for recovery at the production wellbore. Much of the injected CO₂ remains in the reservoir. The CO₂ that does return to the surface with the produced oil is recovered and reinjected creating a closed-loop system.

Currently, about 65 million tons of CO₂ (mostly from natural sources with the rest from industrial and power plants) are used annually for EOR in over 5,000 wells. Larger companies, such as Occidental Petroleum, and smaller ones, such as Denbury Resources, are active EOR operators. Under the Greenhouse Gas Reporting Program, EPA allows companies to receive credit for carbon stored via CO₂-EOR by reporting data on CO₂ injected and stored (mass balance) in the oil field and implementing a measurement, reporting and verification plan. The longest onshore EOR project has been the SACROC project in West Texas for over 40 years, and the largest onshore EOR project, with 7 million tons of CO₂ per year used in EOR or stored, is the Shute Creek operation in Wyoming.

While significant commercial experience with carbon capture exists in certain industrial sectors, too few facilities have been built and tested in the power sector to bring costs

down significantly. Thus, new plants using current CCUS technology are estimated to cause increases in electricity generation cost varying from about \$20-\$50/MW-hr (2013\$) for a natural gas combined cycle (NGCC) plant to \$30-\$70/MW-hour for a supercritical pulverized coal (SCPC) plant. The added cost for an integrated gasification combined cycle (IGCC) plant is estimated to be midway between those values. These values represent increased costs per MW-hour of between 50% to 60% for an NGCC plant and 30-50% for an SCPC plant.

In all cases, the cost of capture (including compression) accounts for the vast majority (approximately 80%) of the cost of capturing, transporting and injecting CO₂. The overall cost of CCUS can be reduced significantly if the captured CO₂ is sold for use in EOR (with the magnitude of savings dependent on the prevailing oil price).

The DOE lists a number of Carbon Capture and Storage projects within the industrial sector. Various projects and technologies are highlighted. View the DOE page [here](#)

Second generation technologies will improve these economics and could result in 25-30% lower capital costs and 20-30% lower operating costs if current R&D goals are met. There are many ideas in various stages of development that may reduce capture costs, such as using membranes, fuel cells, solid sorbents, biomass co-firing, ionic liquids and advanced, more efficient power plant designs. Combining approaches where two different capture technologies are used in sequence could provide a cheaper approach to CO₂ capture. It is also worth mentioning that large scale projects outside the power sector with proven carbon capture capabilities include methane capture projects from coal mines. ICAC member companies have installed very large scale methane capture units at coal mines around the world and ICAC members are developing new and innovative ways to capture methane from coal mines using a variety of technologies.

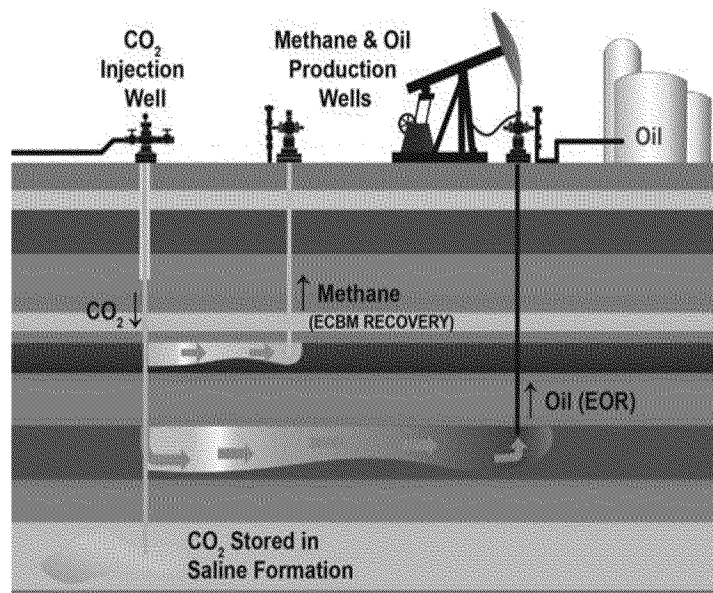
A list of large scale projects and test centers can be found at the conclusion of this paper.

2.2 CO₂ TRANSPORTATION

Transportation of CO₂ via pipelines in the U.S. is not significantly different than transporting oil, gas or natural gas liquids, all of which are currently regulated by the U.S. Department of Transportation. Over 5,000 miles of CO₂ pipelines operate today in the U.S., and over their 40-year history have an outstanding safety record with zero associated fatalities from CO₂ release. Pipeline pressures can be higher because the CO₂ is transported in a dense phase liquid state to sites where it is stored. Most CO₂ pipelines operate under a standard that requires low water content and low concentrations of H₂S.

2.3 CO₂ UTILIZATION AND CONVERSION

Figure 2. Enhanced oil recovery process



As noted previously, a principal use of converted CO₂ has been for use in EOR. The Petra Nova project is perhaps the best example of CO₂ captured from a powerplant and used in an EOR operation. The CO₂ is pipelined to an oil field where it is injected, along with water, into oil bearing formations as a means of forcing additional oil to the surface.

CO₂ is a valuable product in this context and, depending on the price of oil, significant amounts of captured CO₂ could be used for this purpose. Under certain conditions, the CO₂ will remain underground for decades and centuries.

Converting captured CO₂ into useful products is an activity that is in its early stages, with DOE supporting a number of research projects and new technologies for converting CO₂ to chemical and solid products. Captured CO₂ can be converted to useful profitable products, like dry ice or carbonated beverages, which do not convert the carbon long-term, or building materials, which do offer a long-term conversion opportunity. DOE is also supporting early stage research to develop technologies that use biological or mineralization-based concepts or novel physical and chemical processes, which aim to generate economic value with a lower rate of carbon emissions. Some recent projects selected by DOE include direct electron beam synthesis to create chemical products, using microalgae to convert CO₂ to bioplastics, and development of construction materials via industrial waste re-processing and power plant heat integration. Unfortunately, most processes will

take years to mature and it appears that markets are unlikely to be large enough to utilize all the CO₂ being produced by such processes if they were to be implemented at full-scale.

3. SUPPORT FOR CCUS

CCUS has received significant financial support from the federal government and industrial partners, however, more is needed to lower the costs of existing technologies, to support commercialization of emerging technologies and development of additional new and innovative technologies. This support can come in at least two forms: 1. Direct, early-stage support for projects and technologies and 2. Long-term, stable financial incentives that provide certainty, such as a tax credit, for CCUS activities. Both forms have had strong federal support for 20 years and should be continued and even increased.

3.1 GOVERNMENT RESEARCH AND DEVELOPMENT

DOE has pursued research and development of CCUS since 1997. Since FY 2008, Congress has appropriated more than \$7 billion for CCUS activities at DOE. This funding expired at the end of 2015.

The 2017 DOE budget has set aside \$1.4 billion for CCUS and sequestration projects. The FY 2017 budget proposal includes \$170.4 million, 30 percent above FY 2016 enacted, to continue R&D on carbon capture technologies. This includes \$101 million to support construction of four large (10 MWe scale) post-combustion capture pilot plants, three for coal-fired power plants and one optimized to capture CO₂ from a natural gas power system. Funding also supports front-end engineering and design (FEED) studies for two large scale pilot plants (10+MWe) to test advanced low-carbon combustion systems, such as chemical looping and pressurized oxy-combustion.

The Department of Treasury has set aside \$5+ billion in tax incentives for CCUS deployment technologies. The FY 2017 budget re-proposes \$5 billion in two tax incentives that will complement each other in making the deployment of CCUS technologies cost competitive, which in turn will enable additional technology improvements and drive down the costs of follow-on CCUS deployment.

The FY 2017 budget proposes \$2 billion in refundable investment tax credits for projects that capture and permanently sequester CO₂. Credits would be available to new and retrofitted electric generating units. Projects must capture and store at least one million metric tons of CO₂ per year.

The Global CCS Institute has an extensive data base of multiple projects using new and experimental technologies.

A list of Pilot and Demonstration Projects can be viewed here:

<https://www.globalccsinstitute.com/projects/pilot-and-demonstration-projects>

A list of Test Centers and other Initiatives can be found here:

<https://www.globalccsinstitute.com/projects/test-centers-and-other-initiatives>

A list of Co2 Utilization Projects can be found here:

<https://www.globalccsinstitute.com/projects/co2-utilisation-projects>

3.2 SECTION 45Q SEQUESTRATION TAX CREDITS

Section 45Q of the Internal Revenue Code was enacted in 2008 as part of the Energy Improvement and Extension Act, and it was amended by the 2009 stimulus bill. Section 45Q gives a tax credit for carbon capture and sequestration. The credit is available for any taxpayer who: (1) captures “qualified CO₂” (i.e., CO₂ that otherwise would have been released into the atmosphere) and (2) ensures (either physically or contractually) that the CO₂ is captured in secure geological storage or is used as a tertiary injectant (i.e., pumped into oil and gas reservoirs in order to enhance the amount of oil that is extracted from the reservoir).

If the CO₂ is geologically stored, the credit is \$21.85 per metric ton of qualified CO₂. If the CO₂ is used in EOR, the credit is \$10.92 per metric ton of qualified CO₂.

Section 45Q is not a permanent credit and expires when the Treasury Department and EPA together determine that 75 million metric tons of qualified carbon dioxide have been stored or used in EOR. Over half of the 75 million metric tons of CCS have already been credited under Section 45Q. Text of Section 45Q can be found [here](#).

3.3 LEGISLATION

There are a number of bills pending in Congress that aim to extend or make permanent the 45Q tax credit program and to increase the amount of the credit from its current \$10/\$20 level.

S.1663 Senator John Hoeven (R-ND) introduced S.1663, the [CO₂ Regulatory Certainty Act](#) on July 27, 2017. This bill is cosponsored by Senators Steve Daines (R-MT), Roger Wicker (R-MS), John Barrasso (R-WY), and Thad Cochran (R-MS). The bill amends the Internal Revenue Code to revise requirements for secure geological storage of CO₂ for the purpose of 45Q tax credits. Under the bill, the IRS regulations must consider the CO₂ to be disposed of in secure geological storage if it is in

compliance with specified rules promoted by the EPA under the Clean Air Act (CAA) and the Safe Drinking Water Act (SDWA).

S.1535 U.S. Senators Heidi Heitkamp (D-ND), Sheldon Whitehouse (D-RI), Shelley Moore Capito (R-WV) and John Barrasso (R-WY) introduced S.1535, The [FUTURE Act](#) on July 12, 2017. The bill has two dozen bipartisan Senate cosponsors, and is supported by the coal sector and a number of environmental groups, including the Natural Resources Defense Council. The bill was crafted with the purpose of both accelerating and incentivizing the development and use of carbon capture, utilization and storage technologies and processes. The legislation would support a path forward for existing sources of energy like coal, while spurring adoption of low-carbon technologies that can transform carbon pollution into useable products.

The [FUTURE Act](#) would extend and increase tax credits for power generators and industrial facilities that capture and sequester their carbon, as well as for carbon utilization — the conversion of carbon dioxide into useable products and fuels.

The bill would extend the 45Q tax credit and the “commence construction” window for projects from five to seven years and increase the time available to claim credits from 10 to 12 years. The bill would provide a \$50 tax credit for every metric ton of carbon stored underground and \$35 per ton for carbon utilized for purposes such as enhanced oil recovery. Currently, credits of \$20 and \$10 per ton are offered for capture and utilization, respectively.

H.R. 2010 Representative Kevin Kramer (R-ND) introduced H.R. 2010, the [CO2 Regulatory Certainty Act](#) on April 6, 2017. The bill is cosponsored by Representatives David McKinley (R-WV), Jeff Duncan (R-SC), Steven Palazzo (R-MS), Gregg Harper (R-MS), and Sam Johnson (R-TX). The House counterpart to S.1663 mentioned above, this bill aims to amend the Internal Revenue Code to enhance requirements for secure geological storage of CO2 for the purpose of 45Q tax credits.

S. 843 US Senators Rob Portman (R-OH) and Michael Bennet (D-CO) introduced S. 843, the [Carbon Capture Improvement Act](#) in April 2017.

This bill amends the Internal Revenue Code to authorize the issuance of tax-exempt facility bonds for the financing of qualified CO2 capture facilities. These bonds are exempt from a number of regulatory restrictions and can lower the cost of capital and extend the time horizon for repayment.

H.R. 4622 Representative Mike Conaway (R-TX) introduced H.R. 4622, The [Carbon Capture Act](#), in February 2016 with the 114th Congress. As with the S. 1535 reviewed above, its primary aim was to extend the 45Q tax credit. However, it made four changes to 45Q.

Listed below are the four changes:

1. Make the 45Q credit permanent after 2015,
2. Increase the credit after 2024 for a qualified facility originally placed in service after December 31, 2015,
3. Allow credit to a person who disposes of, or uses as a tertiary injectant, the carbon dioxide; and
4. Modify the definition of "qualified facility" for purposes of eligibility for such credit to require not less than 150,000 metric tons (currently, 500,000 metric tons) to be captured at such a facility during the taxable year.

On May 24, 2017, Resources for the Future held a conference titled, **The Future of Carbon Capture, Utilization, and Storage (CCUS): Status, Issues, Needs**

It was attended by multiple experts and stakeholders from industry, academia and government.

A link to the entire conference can be found here:

<http://www.rff.org/events/event/2017-05/future-carbon-capture-utilization-and-storage-ccus-status-issues-needs>

The proposals noted above show that there is widespread bipartisan support in Congress for legislation incentivizing and supporting CCUS, as well as significant support from a variety of constituent interests. In February 2016, a key group of outside interests, including representatives of Occidental Petroleum, Peabody Coal, Arch Coal, Cloud Peak Energy, Archer Daniels Midland and major environmental groups, including the Natural Resources Defense Council and the Clean Air Task Force, along with union representatives from the AFL-CIO sent a [letter](#) to the Chairman and Ranking Member of the House Appropriations Committee calling for a permanent extension of the 45Q credit. Support for CCUS has continued and in some contexts, even increased, following the results of the 2016 election.

4. LOOKING FORWARD

There is no question that fossil fuels will continue to play a large role in our energy mix and that coal, natural gas and petroleum will be needed for decades to come in order to provide energy independence in the U.S. and power the world economy. Carbon management, including carbon capture, utilization and storage or sequestration, is the key to an environmentally sustainable future for coal and natural gas used in power generation and industrial applications.

The U.S. is a world leader in this area and has already invested billions of dollars into developing these kinds of technologies. However, more research and development support is needed to lower costs and develop new technologies. It is critically important that the EPA and DOE work together to assess funding opportunities and to direct funding toward those opportunities with the greatest likelihood of success. Any potential infrastructure package should provide funding for CCS infrastructure, including for CO₂ pipelines and other CCUS related infrastructure at both EOR sites and at other locations. Congress has shown bipartisan interest in partnering with the Executive Branch and private entities to provide the proper combination of incentives for further research, commercialization and deployment of CCUS. EPA can play a key role in fostering and augmenting this partnership. However, in order to foster long term development of CCUS and provide the stable horizon necessary for investment in such technologies at scale, both a market driver and a long-term funding/incentive program is needed. Without a regulatory driver to create on-going markets, an R&D component alone cannot fully incentivize widespread deployment of CCUS technologies. Enhanced oil recovery can provide an important bridge, as well as certain utilization technologies that can convert CO₂ into marketable products. However, even these activities cannot by themselves provide sufficient drivers to achieve needed levels of CCUS.

It is imperative that the U.S. maintain its leadership role in these technologies, which can provide an important export opportunity for U.S. industry. EPA has a valuable role to play in this regard, a role that will help further the mission of environmental protection and clean air stewardship, while helping to grow the U.S economy and increase the domestic job base.

ICAC looks forward to working with EPA on these and other issues.

Figure 3. Large Scale CCS Projects Worldwide (Global CCS Institute)

Large Scale CCS Projects Around the World as Reported by the Global CCS Institute

| Project name | Location | Operation date | Industry | Capture type | Capture capacity (Mtpa) | Transport type | Primary storage type | Stage |
|--|---------------|----------------|------------------------|---|-------------------------|--|------------------------------|---------|
| Terrell Natural Gas Processing Plant (formerly Val Verde Natural Gas Plants) | United States | 1972 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 0.4 - 0.5 | Pipeline | Enhanced oil recovery | Operate |
| Enid Fertilizer CO ₂ -EOR Project | United States | 1982 | Fertilizer Production | Industrial Separation | 0.7 | Pipeline | Enhanced oil recovery | Operate |
| Shute Creek Gas Processing Facility | United States | 1986 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 7 | Pipeline | Enhanced oil recovery | Operate |
| Sleipner CO ₂ Storage Project | Norway | 1996 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 1 | No transport required (direct injection) | Dedicated Geological Storage | Operate |
| Great Plains Synfuels Plant and Weyburn-Midale Project | Canada | 2000 | Synthetic Natural Gas | Pre-combustion capture (gasification) | 3 | Pipeline | Enhanced oil recovery | Operate |
| Core Energy/South Chester Gas Processing Plant | United States | 2003 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 0.4 | Pipeline | Enhanced oil recovery | Operate |
| Snøhvit CO ₂ Storage Project | Norway | 2008 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 0.7 | Pipeline | Dedicated Geological Storage | Operate |
| Chaparral/Conestoga Energy Partners' Arkalon Bioethanol Plant | United States | 2009 | Ethanol Production | Dehydration and compression from fermentation. | 0.17 | Pipeline | Enhanced Oil Recovery | Operate |
| Century Plant | United States | 2010 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 8.4 | Pipeline | Enhanced oil recovery | Operate |

| | | | | | | | | |
|---|----------------------|------|---------------------------|---|-----|--|------------------------------|---------|
| Conestoga Energy Partners/PetroSantander Bonanza Bioethanol Plant in Kansas | United States | 2012 | Ethanol Production | Dehydration and compression from fermentation. | 0.1 | Pipeline | Enhanced Oil Recovery | Operate |
| Air Products Steam Methane Reformer EOR Project | United States | 2013 | Hydrogen Production | Industrial Separation | 1 | Pipeline | Enhanced oil recovery | Operate |
| Coffeyville Gasification Plant | United States | 2013 | Fertilizer Production | Industrial Separation | 1 | Pipeline | Enhanced oil recovery | Operate |
| Lost Cabin Gas Plant | United States | 2013 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 0.9 | Pipeline | Enhanced oil recovery | Operate |
| Petrobras Santos Basin Pre-Salt Oil Field CCS Project | Brazil | 2013 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 1 | No transport required (direct injection) | Enhanced oil recovery | Operate |
| Boundary Dam Carbon Capture and Storage Project | Canada | 2014 | Power Generation | Post-combustion capture | 1 | Pipeline | Enhanced oil recovery | Operate |
| Quest | Canada | 2015 | Hydrogen Production | Industrial Separation | 1 | Pipeline | Dedicated Geological Storage | Operate |
| Uthmaniyah CO ₂ -EOR Demonstration Project | Saudi Arabia | 2015 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 0.8 | Pipeline | Enhanced oil recovery | Operate |
| Abu Dhabi CCS Project (Phase 1 being Emirates Steel Industries (ESI) CCS Project) | United Arab Emirates | 2016 | Iron and Steel Production | Industrial Separation | 0.8 | Pipeline | Enhanced oil recovery | Operate |
| Illinois Industrial Carbon Capture and Storage Project | United States | 2017 | Chemical Production | Industrial Separation | 1 | Pipeline | Dedicated Geological Storage | Operate |
| Petra Nova Carbon Capture Project | United States | 2017 | Power Generation | Post-combustion capture | 1.4 | Pipeline | Enhanced oil recovery | Operate |

| | | | | | | | | |
|---|---------------|------|------------------------------------|---|-----------|--|------------------------------|---------|
| Gorgon Carbon Dioxide Injection Project | Australia | 2017 | Natural Gas Processing | Pre-combustion capture (natural gas processing) | 3.4 - 4.0 | Pipeline | Dedicated Geological Storage | Execute |
| Kemper County Energy Facility | United States | 2017 | Power Generation | Pre-combustion capture (gasification) | 3 | Pipeline | Enhanced oil recovery | Execute |
| Alberta Carbon Trunk Line ("ACTL") with Agrium CO ₂ Stream | Canada | 2018 | Fertilizer Production | Industrial Separation | 0.3 - 0.6 | Pipeline | Enhanced oil recovery | Execute |
| Alberta Carbon Trunk Line ("ACTL") with North West Sturgeon Refinery CO ₂ Stream | Canada | 2018 | Oil Refining | Industrial Separation | 1.2 - 1.4 | Pipeline | Enhanced oil recovery | Execute |
| Yanchang Integrated Carbon Capture and Storage Demonstration Project | China | 2018 | Chemical Production | Pre-combustion capture (gasification) | 0.4 | Combination | Enhanced oil recovery | Execute |
| Tomakomai Carbon Capture and Storage Demonstration Project | Japan | 2017 | Hydrogen Production (Oil Refining) | Industrial Separation | 0.1 | No transport required direct injection | Dedicated geological storage | Operate |
| Osaki CoolGen Project | Japan | 2019 | Power Generation | Pre Combustion Capture (Gasification) | 1 | No transport involved | Storage not involved | Execute |

Note: Three U.S. projects, Core Energy/South Chester, Chaparral/Conestoga Energy Partners, and Conestoga Energy Partners/Petro Santander, were identified by Great Plains Institute and added at their suggestion.



THE INSTITUTE OF CLEAN AIR COMPANIES (ICAC)
DOMESTIC CONVENTIONAL POLLUTANTS DIVISION
AND EMISSIONS MEASUREMENT DIVISION

Issue Brief for
United States Environmental Protection Agency
Administrator E. Scott Pruitt



EXECUTIVE SUMMARY

ICAC member companies have helped to clean the air over the past five decades by developing and installing reliable, cost effective control and monitoring systems that have enabled compliance with evolving environmental requirements. ICAC has achieved reductions across a broad range of pollutants, including mercury, NO_x, SO_x and particulate matter, as well as VOCs, acid gases and a host of other toxic air pollutants. ICAC stands ready to assist EPA in further cost-effective air pollution reduction efforts and in developing the most accurate and reliable monitoring systems for air pollutants such as ozone.

1. HISTORICAL OVERVIEW

The Institute of Clean Air Companies (ICAC) is the national non-profit trade association of companies that supply air pollution control and monitoring systems, equipment, reagents/sorbents, and services for stationary sources. ICAC has promoted the air pollution control industry and encouraged the improvement of engineering and technical standards since 1960. Our members include more than 50 companies who are leading manufacturers of equipment to control and monitor emissions of particulate matter (PM), volatile organic compounds (VOC), sulfur dioxide (SO₂), nitrogen oxides (NO_x), hazardous air pollutants (HAP), mercury, acid gases, and greenhouse gases (GHG). ICAC's collective technical expertise is, and will continue to be, an important resource for coal-fired boilers and other sources of air pollution.

ICAC member companies have made substantial advancements in technologies for reliable and cost-effective measurement of criteria and hazardous air pollutants, enabling timely implementation and compliance with acid rain and hazardous air pollutant regulations. These include:

- Mercury and HCl real-time monitoring in support of the utilities complying with the Mercury and Air Toxics Standards (MATS) rule as well as other industrial sources driven by NESHAP rules.
- Particulate matter (PM) real-time monitoring for compliance with the MATS rule as well as other NESHAP rules.
- Monitoring for ozone and other criteria pollutants for sources in states implementing primary national ambient air quality standards.

Furthermore, ICAC member companies have substantially advanced technology for cost-effective control of emissions from industrial and utility applications, resulting in high control efficiency of criteria and hazardous air pollutants, enabling compliance with federal, state and permitted emissions levels at costs that were lower than predicted, for a broad range of industrial applications. These technologies have enabled high levels of control:

- VOCs: typical destruction efficiencies of greater than 98% for a wide range of applications
- PM: removal greater than 95% with a wide range of technologies
- NO_x: removal of greater than 95% at temperatures ranging from 300°F to 2,000°F
- SO₂: removal of greater than 90% with dry sorbent injection (DSI) of alkaline sorbents, greater than 95% with dry or wet flue gas desulfurization
- Hg: removal of greater than 90% commercially implemented with non-material impact to plant operating costs
- Acid gases: greater than 90% HCl control and greater than 95% SO₃ control demonstrated with DSI
- CO: control up to 99% efficiency at more than 1,000 power plants and industrial boilers

ICAC member companies are ready to meet the challenges ahead both in terms of improving reliability and detection limits of important species in ambient and industrial settings and in terms of lowering the cost and control effectiveness of technologies to support Clean Air Act and other standards.

The chart below provides some basic information about installed controls in the U.S.

Table 1. Quantity and Net Summer Capacity of Operable Environmental Equipment, 2004 – 2014 (EIA data; see Note¹)

| Year | Flue Gas Desulfurization Systems | | Electrostatic Precipitators | | Baghouses | | Select Catalytic and Non-Catalytic Reduction Systems | | Activated Carbon Injection Systems | | Direct Sorbent Injection Systems | |
|------|----------------------------------|-------------------------------------|-----------------------------|-------------------------------------|-----------|-------------------------------------|--|-------------------------------------|------------------------------------|-------------------------------------|----------------------------------|-------------------------------------|
| | Quantity | Associated Net Summer Capacity (MW) | Quantity | Associated Net Summer Capacity (MW) | Quantity | Associated Net Summer Capacity (MW) | Quantity | Associated Net Summer Capacity (MW) | Quantity | Associated Net Summer Capacity (MW) | Quantity | Associated Net Summer Capacity (MW) |
| 2004 | 535 | 112,874 | 1,555 | 324,712 | 527 | 57,745 | 980 | 215,955 | 123 | 4,435 | 47 | 5,820 |
| 2005 | 539 | 112,372 | 1,542 | 324,511 | 527 | 57,948 | 1,058 | 235,221 | 128 | 4,693 | 47 | 6,765 |
| 2006 | 538 | 115,698 | 1,494 | 317,408 | 538 | 60,556 | 1,141 | 254,455 | 139 | 6,859 | 55 | 7,333 |
| 2007 | 565 | 129,555 | 1,494 | 317,296 | 555 | 65,587 | 1,176 | 263,382 | 141 | 7,735 | 56 | 7,407 |
| 2008 | 612 | 149,575 | 1,469 | 316,356 | 575 | 68,357 | 1,227 | 274,510 | 169 | 17,391 | 59 | 7,506 |
| 2009 | 652 | 172,829 | 1,454 | 313,902 | 596 | 73,778 | 1,299 | 296,598 | 227 | 39,546 | 62 | 8,047 |
| 2010 | 691 | 199,107 | 1,408 | 310,031 | 609 | 83,322 | 1,337 | 312,208 | 262 | 54,183 | 63 | 8,527 |
| 2011 | 704 | 209,618 | 1,362 | 306,447 | 632 | 98,422 | 1,385 | 328,228 | 274 | 59,057 | 72 | 8,783 |
| 2012 | 699 | 217,024 | 1,284 | 297,817 | 628 | 101,508 | 1,427 | 341,785 | 287 | 63,709 | 80 | 10,424 |
| 2013 | 674 | 219,019 | 1,205 | 288,633 | 634 | 104,141 | 1,427 | 347,327 | 259 | 61,085 | 93 | 12,740 |
| 2014 | 669 | 223,305 | 1,159 | 283,391 | 617 | 105,580 | 1,440 | 354,277 | 277 | 68,697 | 98 | 15,918 |

¹ Note: 'Associated Net Summer Capacity' is defined as the net summer capacity of the generators that are associated with the operation of this environmental equipment. In some cases, respondents have reported equipment late. Counts and capacity may have changed from prior publications of this table because of late reporting. Data for 2005 and earlier are based primarily on Form EIA-767 data. In 2006, the Form EIA-767 was suspended. Data for 2007 and later are based primarily on Form EIA-860 data. All data for 2006 are inferred based on submissions from subsequent years. Beginning in 2013 environmental data was collected at a more detailed level, which increases its accuracy and, in some cases, reduces the equipment counts.

2. MERCURY CONTROL: A SUCCESS STORY

Mercury control is successful and very cost-effective today for coal-fired processes (including power plants) as a result of decades of technology development work that was driven by confidence in national-level mercury control regulation. Operating costs under all of MATS (including mercury controls) have dropped to a range of less than \$1.00/MW-hr (averaging \$0.50/MW-hr) for coal-fired power plants.²

2.1 WHY MERCURY FROM COAL?

The common knowledge that mercury is a persistent neurotoxin (as exemplified in fish advisories nationally) and EPA's and states' multiple efforts at regulation of mercury has reinforced that this was a pressing problem. For example, as described in the opening statement of Mercury Control from Coal Combustion by the UN Global Mercury Partnership³:

“Burning of coal is the largest single anthropogenic source of mercury air emissions, having more than tripled since 1970. Coal burning for power generation is increasing alongside economic growth. The releases from power plants and industrial boilers represent today roughly a quarter of mercury releases to atmosphere. Household burning of coal is also a significant source of mercury emissions and a human health hazard. Although coal contains only small concentrations of mercury, it is burnt in very large volumes. Up to 95% of mercury releases from power plants can be reduced. This can be achieved by improving coal and plant performance, and optimizing control systems for other pollutants.”

Mercury pollution can lead to contaminated fish, which when eaten can lead to a variety of dangerous health effects. The sensitivity of vulnerable populations such as pregnant women and children, as well as subsistence fishermen, to exposure has led EPA and numerous states to issue a number of advisories and to provide other information regarding the dangers posed by mercury in contaminated fish.⁴

In order to address this pressing need, control technologies available for meeting mercury and other limits under the MATS rule have been developed over many

² Staudt, J.E., “Update of the Cost of Compliance with MATS – Ongoing Cost of Controls,” White Paper by Andover Technology Partners, May 2017.

³ Sloss, Lesley and Peter Nelson. “Mercury Control from Coal Combustion.” UN Environment. United Nations, n.d. Web. 25 July 2017 <<http://www.unep.org/chemicalsandwaste/global-mercury-partnership/mercury-control-coal-combustion>>.

⁴ “Guidelines for Eating Fish That Contain Mercury.” EPA. Environmental Protection Agency, 19 Jan. 2017. Web. 11 Aug. 2017. <<https://www.epa.gov/mercury/guidelines-eating-fish-contain-mercury>>.

years and summarized by others, as in the reports “Assessment of Technology Options Available to Achieve Reductions of Hazardous Air Pollutants”⁵ and “Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants.”⁶

2.2 TECHNOLOGY INVESTMENT AND DEVELOPMENT

Development for technology and demonstrations was funded by the EPA, the Department of Energy, the Electric Power Research Institute (EPRI), and by suppliers of sorbents, equipment providers, measurement suppliers, and by numerous utility sources. The evaluation, development, and commercialization of mercury control technologies began soon after the passing of the Clean Air Act Amendments.

From the period of 1990 to 1997, the DOE Mercury Measurement and Controls Program evolved from studies of Hazardous Air Pollutants performed in that time. These studies were performed on several power plants around the United States. The major finding concluded that mercury was not well controlled using the installed air pollution control devices. DOE ran these studies in collaboration and joint funding with EPRI, the University of North Dakota Energy and Environmental Research Center (UNDEERC) and numerous utility companies, including Southern Company, Ohio Power, Illinois Power Minnesota Power and many others.

In 2000, DOE/NETL (National Energy Technology Laboratory) began a comprehensive test program of the most promising mercury control technologies at coal fired utilities around the country. This test program was completed in three distinct phases, moving from pilot-scale testing to full-scale testing, and eventually, into driving additional control efficiency at less cost to the utility. Overall, DOE/NETL co-funded over 40 full-scale mercury tests at utility sites with various air pollution control devices burning a variety of coal types. Additionally, several lab and pilot-scale test programs were funded to further the understanding and technology development. These programs were jointly funded by industry, technology developers, including many ICAC members, the government and EPRI.

Reliable measurement of mercury emissions proved to be difficult early in the testing programs. Since the 1990s development work was conducted on the sorbent trap measurement method, a lower-cost method in comparison with more cumbersome, manual wet chemistry methods such as the Ontario Hydro method and EPA Method 29, a multi-metals measurement method. In addition, developers invested significantly in continuous mercury measurement technology in conjunction with these testing programs and independently. Between 2004 and

⁵ Lipinski, George, P.E., Jean Leonard, and Carl Richardson, PhD. Assessment of Technology Options Available to Achieve Reductions of Hazardous Air Pollutants. Austin: URS Corporation, 2011. Web. 6 July 2017 <http://www.lexisecuritiesmosaic.com/gateway/FedReg/file_4-8-11-URSTechnologyReport.pdf>.

⁶ Staudt, James E., PhD. Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants. Boston: NESCAUM, 2011. Web. 6 July 2017 <www.nescaum.org/documents/coal-control-technology-nescaum-report-20110330.pdf>.

2006, DOE and UNDEERC jointly sponsored a \$3,000,000 program to further develop the measurement of mercury emissions. ICAC members also contributed significantly to the development and documentation of EPA Method 324, which eventually was adapted and adopted as the current sorbent trap mercury measurement methods 30A and 30B.

2.3 INVESTMENT, COMMERCIALIZATION AND PRESENT-DAY IMPLEMENTATION

MATS⁷ established a clear market need for mercury control equipment, chemicals, and supporting measurements. ICAC member companies responded to this market need, having invested in technology development specific to coal-fired power plants and other dilute, mercury-containing gas streams over many years, transferring applicability from sources such as municipal solid waste combustion gases. ICAC members worked to develop technologies that worked under a wide range of mercury concentrations and chloride contents.

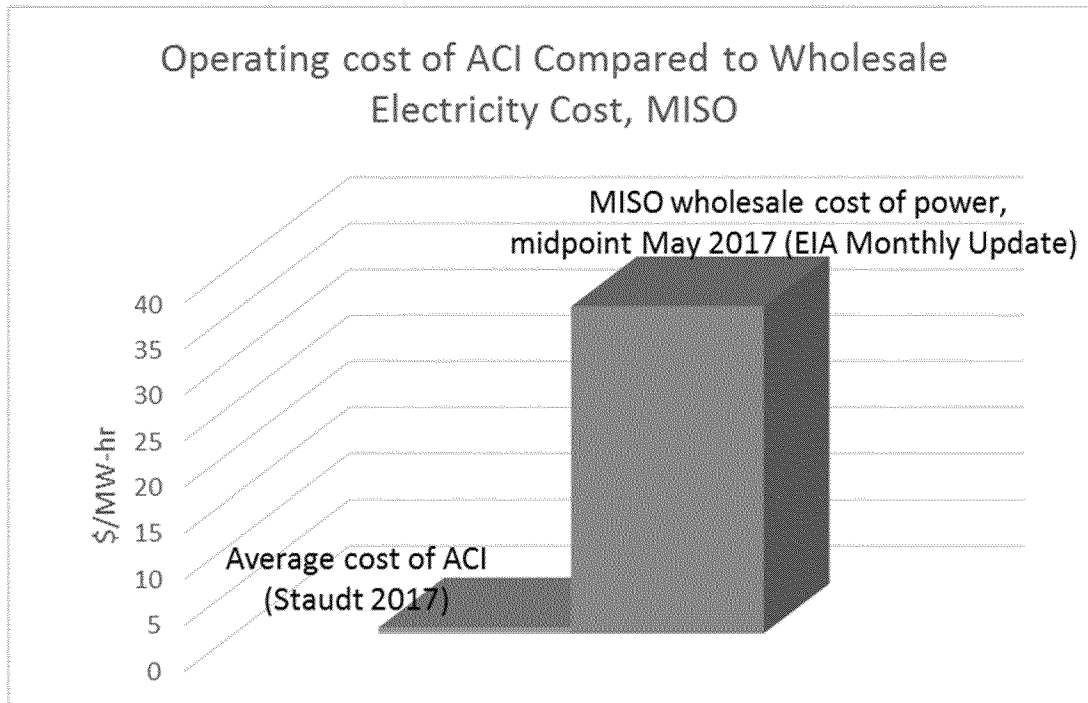
When it came time to fully commercialize and scale up the equipment and chemical supplies that MATS rule compliance demanded, the air pollution control industry invested in new production facilities here in the U.S. to provide the equipment, measurements, and activated carbon and other reagents and sorbents needed to address the new demand. ICAC members also continued to evolve other technical solutions including fuel blending and existing control optimization, non-carbon sorbents, improvements to carbon-based sorbents, wet and dry scrubber additives, and oxidizing coal additives. Having multiple options in place, as well as a robust industry of suppliers that drive innovation through internal research and development, dramatically reduces the costs of compliance for end users over time.

Activated carbon, for example, which is the dominant chemical used for control of mercury from coal-fired flue gases, has several ICAC-member domestic suppliers. Collectively they invested at least \$750 million in manufacturing and logistics facilities and opened two new coal mines (in Texas and Louisiana) to supply the raw material for activated carbon production. States like Louisiana, Texas, Oklahoma, Mississippi, Wyoming, Kentucky, Virginia, West Virginia, Ohio and Pennsylvania all benefit from well-paying jobs at ICAC member company facilities and in related industries like coal mining, which is important for both energy use and as a source of consumable product. The benefits to the local and state economies from these operating facilities and mines, as well as the transportation and distribution of products, are significant. In addition, the activated carbon industry has continued to invest in research and development, improving the products available and reducing

⁷ Prior to MATS, ICAC members invested substantial amounts of resources in technology aimed at meeting the requirements of the Clean Air Mercury Rule, only to have that rule overturned. Work done to ensure compliance with MATS could face a similar outcome, which ICAC believes should be avoided through a path that provides long-term regulatory certainty.

the costs of compliance. The cost reductions and improvements in technology have had the material benefit of enabling coal-fired power generators to operate their plants with flexibility and cleaner emissions while keeping costs of compliance low. Further information regarding costs, which vary depending on the technology, can be found in reference 2, which is also attached to this document as Attachment B. Figure 1 below shows the average operating cost of ACI in comparison with the midpoint of wholesale electricity pricing in MISO from May 2017.

Figure 1. Average operating cost of ACI compared to wholesale electricity pricing in MISO



Activated carbon injection is one of several technologies used to control mercury from coal-fired power plants. Alternatives have continued to evolve as well, with suppliers optimizing their chemicals and controls. The availability of ICAC-supported technologies for mercury control allows ever-improving mercury compliance options. These technologies support clean coal power generation.

A recent U.S. Energy Information Administration (EIA) report indicates that a significant number of electric power plants have invested in equipment as a response to the EPA’s MATS rule. With the initial MATS compliance date of April 2015 coupled with the one-year compliance extension granted to many utilities, the EIA report indicates that between January 2015 and April 2016, approximately 87GW of coal-fired plants installed pollution control equipment. Some plants, totaling 2.3 GW, received another one-year extension allowing them until April 2017 to comply.

Figure 2. Summary of Regulatory and Technology Progress in Mercury Control



3. ACID GAS

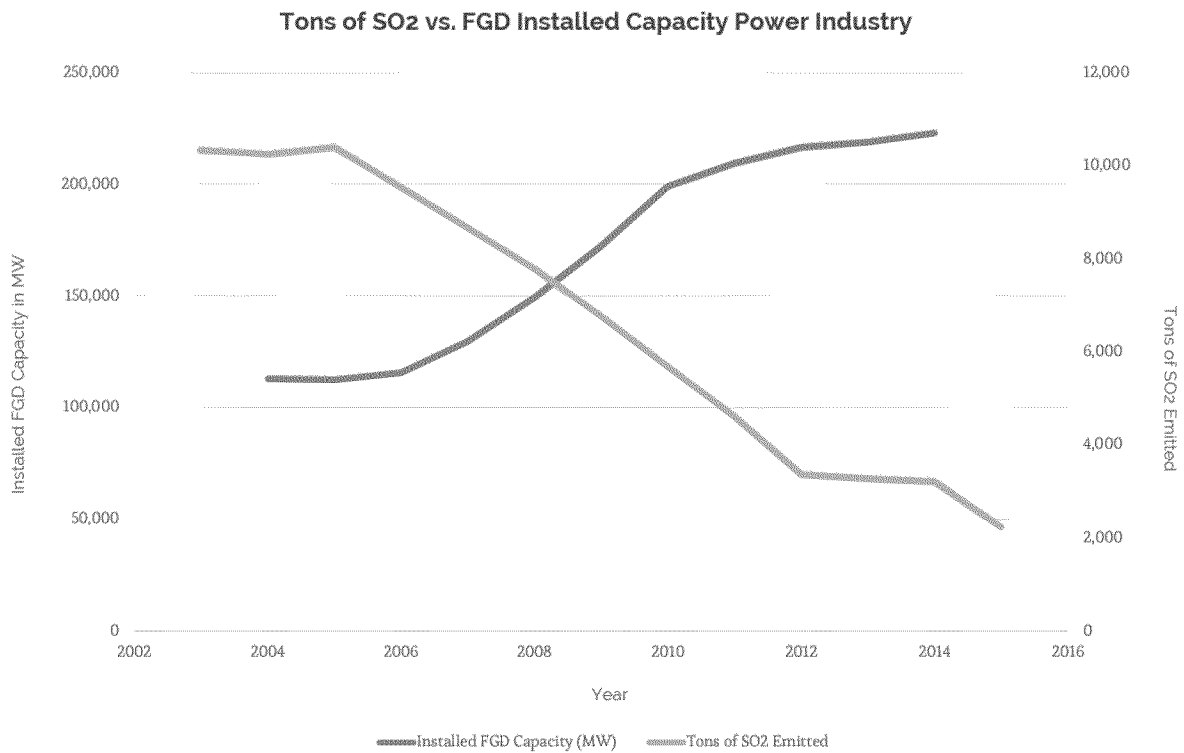
Acid gas removal for high sulfur coal units is predominantly handled by wet or dry Flue Gas Desulfurization (FGD) technology, which is quite expensive, costing as much as a billion dollars in capital costs for a single facility. By 2010, most units burning high sulfur coal had installed wet FGD. Attention since then has been on units burning blends of lower sulfur western coals such as Powder River Basin (PRB) coal. Many PRB units have been able to treat their acid gases with Dry Sorbent Injection (DSI) systems that typically can be installed at much lower capital costs (under \$20 million).

DSI technology injects into the flue gas stream either calcium-based products such as hydrated lime, or sodium based products such as trona or sodium bicarbonate (baking soda). With DSI technology, smaller units that could not afford wet FGD or units that expect a limited life that could not justify a high capital cost system, are able to reduce their acid gas emissions with these simple-to-install systems.

The MATS rule and the Boiler MACT have driven many facilities to this technology in order to meet HCl limits. SO₂ has been less direct, as there are no stack limits. Instead, it is driven by state allocations or ambient air standards. Facilities treating for SO₂ reduction since 2010 have largely been the result of consent orders negotiated with the state regulators

and driven by Regional Haze or NAAQS (National Ambient Air Quality Standards). Utilities and industrial facilities continue to improve their acid gas emissions as more DSI systems are installed.

Figure 2. Tons of SO2 vs. FGD Installed Capacity, Power Industry ⁸



4. NOX, VOCS AND OZONE

Ground level ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, and chemical solvents and vapors are some of the major sources of NOx and VOC.

⁸ U.S. Energy Information Administration, Forms EIA-767, "Steam-Electric Plant Operation and Design Report" and Form EIA-860, "Annual Electric Generator Report."

4.1 HISTORY OF NOX CONTROL TO MEET EMISSION STANDARDS

NOx emissions contributed significantly to national environmental problems, including acid rain, ground level ozone and elevated fine particulate levels. In response to the emissions from power plants, one of the first regulatory drivers was the Acid Rain Program that was established through Title IV of the amendments to the 1990 Clean Air Act (CAA). This program included a two-phased strategy to reduce NOx emissions from coal-fired power plants, with Phase I beginning on January 1, 1996 and Phase II beginning on January 1, 2000.

The primary method of compliance for the Acid Rain Program was through the application of Low NOx burner (LNB) technology and emissions averaging across multiple boilers within a company's fleet of boilers. This was very cost-effective, as it did not require major capital retrofits.

Another driver for the installation of NOx control technologies was established under Title I of the CAA, the NAAQS for ozone. EPA set the 1997 ground-level ozone standard at 80 parts per billion (ppb), which led to the development of the NOx SIP Call Rule of 1998. The NOx SIP Call required 23 eastern states and the District of Columbia to participate in a regional cap-and-trade program.

At the time, conventional technologies, such as low NOx burners, were unable to achieve this level of emissions reduction, spurring ICAC members to develop, refine and apply selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) as post-combustion technologies to control NOx emissions on utility and industrial boilers, gas turbines, process heaters, internal combustion engines, chemical plants, and steel mills. This is key, because in many cases SNCR, a low-capital solution, was sufficient for plants to maintain ozone-season compliance. The regulations that were developed in response to ozone issues spurred the application of (SCR) and (SNCR) on a broad range of industrial sources of NOx emissions.

Emissions reductions of nitrogen oxides on coal-fired power plants and other applications of greater than 90 percent are common with SCR, although this technology may be used economically for lower removal efficiencies as well. SNCR technology provided 20 to 70 percent removal, depending on the type of combustion unit and baseline NOx levels, at a lower capital cost than SCR. The application of these post combustion technologies has allowed plant operators flexibility to apply multiple solutions to meet the overall NOx reduction requirements.

Additional EPA Standards related to NOx and ozone included:

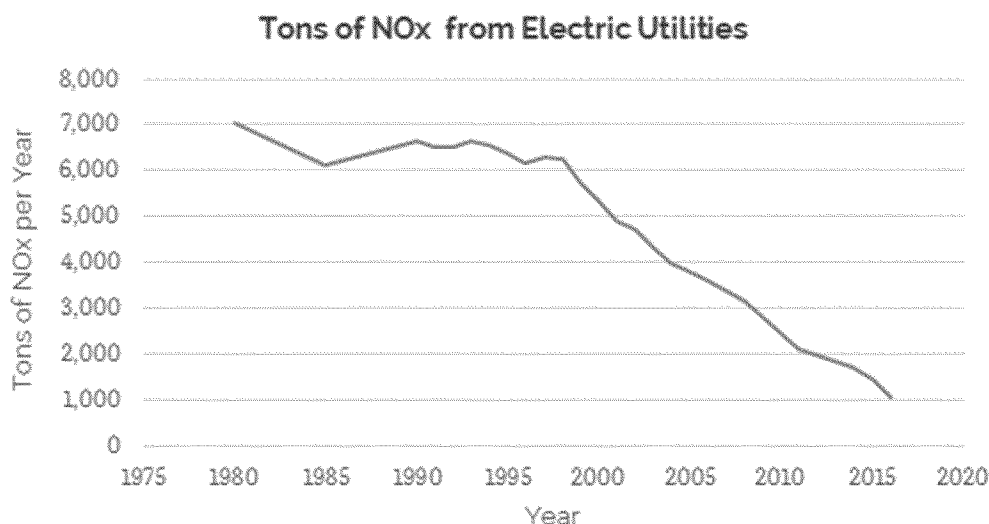
- EPA's 2008 ozone standards of 75 ppb
- EPA's Clean Air Interstate Rule (CAIR)
- the Cross-State Air Pollution Rule (CSAPR)
- The CSAPR Update Rule

- EPA’s Regional Haze program/BART rule.

4.2 ICAC MEMBER TECHNOLOGIES FOR NOX CONTROL

Over the past 25 years, ICAC member companies have provided NOx control solutions using combustion and post-combustion technologies, along with advances in monitoring, to meet the ever-changing NOx emissions standards. The costs of these solutions have continued to decline even while NOx levels are at a fraction of original levels. ICAC members have supported industry and states throughout the years as they implement EPA rules with the ultimate goal of meeting their SIP requirements and NAAQS standards. The ICAC solutions have provided economic flexibility by allowing sources to implement a variety of solutions across their fleets while minimizing any impacts on other plant operations. These solutions have included performance guarantees from ICAC suppliers to allow sources and states to develop compliance strategies and provide certainty for planning and implementation. ICAC member companies stand ready to meet the performance and schedule needs for the next wave of NOx reduction for ozone NAAQS, regional haze or state compliance.

Figure 3. Tons of NOx from Electric Utilities⁹



⁹ “Air Pollutant Emissions Trends Data.” EPA. Environmental Protection Agency, 28 Feb. 2017. Web. 26 July 2017. <<https://www.epa.gov/air-emissions-inventories/air-inventories/air-pollutant-emissions-trends-data>>.

4.3 VOC CONTROLS

VOC controls have been deployed for over 40 years, and today it is routine to achieve 95% plus VOC control very cost-effectively. The critical aspect of controlling VOC emissions is the maintenance of the control device and regular testing to ensure compliance is met. As with all VOC control devices, performance can change due to a wide variety of process, mechanical, or chemical changes that can impact the efficacy of the device.

VOC consist of a variety of organic compounds such as aliphatic and aromatic hydrocarbons, alcohols, ketones, esters, ethers, formaldehyde, phthalic anhydride and many, many others. VOC are vented or discharged from a wide range of manufacturing processes, from can coating and automobile painting to semiconductor manufacture, baking, printing and lithography, paper manufacture, textile manufacture, oil production, plastic production and many more. The VOC may be solvents, unreacted feedstock or decomposition products, depending upon the type of process and process conditions.

Broadly speaking, there are two strategies for reducing VOC emissions from industrial sources: 1) altering the manufacturing process to reduce the amount of VOC produced and 2) installing after-treatment controls to destroy the VOC emissions generated. Some VOC emission reduction can be achieved by process modifications, but in most instances, reductions significant enough to meet abatement requirements of more than ninety-five percent require after-treatment devices to oxidize (incinerate) the VOC. In a small number of applications where the gaseous emissions present in the waste gas are valuable enough to be recovered for recycling or resale, or where their volume is too great to incinerate economically, a collection technology such as carbon adsorption, or refrigeration (condensation) may be the economic choice.

To meet tough VOC restrictions, an engineer's first choice is to modify the process to lower or eliminate the emission rate. In a combustion operation, for example, one option would be to use oxygen instead of air for more efficient combustion, but increased oxygen brings safety issues and isn't always viable. By contrast, for processes that use solvents, such as drying or curing operations, one might choose to recycle the emissions via adsorption, condensation or solvent-recycling techniques. For very strict VOC targets, however, stronger mitigation measures are necessary. While air scrubbing is often employed in such cases, oxidation is required to achieve levels of destruction as high as 99%.

As emission control device providers encounter new emission sources, they have a broad array of technologies to deploy to meet just about any situation. Innovations continue to lower the cost of compliance, improve sustainability, and find new ways to use VOC emissions for economic benefit.

5. OZONE MONITORING AND NORTH AMERICAN BACKGROUND LEVELS

One question that Administrator Pruitt raised related to monitoring for background levels of ozone. Perhaps surprisingly, monitoring of ozone began in the 1800s and has been going on now for more than 150 years. However, the accuracy of early monitoring techniques cannot be fully ascertained and the use of such techniques were applied inconsistently, both spatially and temporally. These features make it difficult to rely on early monitoring as evidence of “natural” background or “clean” sites.

Although we now have much more reliable monitoring techniques, more complete monitoring networks and more continuous monitoring, the issue of determining background continues to be technically difficult. The complicating issues include medium and long-range transport, increased ozone levels world-wide, downward transport of stratospheric ozone and “exceptional” or episodic weather events. For a discussion of some of these issues, click on the following link to review a paper by Dr. Alan Lefohn: <http://www.asl-associates.com/back.htm>

ICAC believes that a more robust (EPA funded) network of monitors would provide EPA with greater insight regarding the presence and sources of tropospheric ozone around the country. That is not to say more monitors would fully address the background vs. anthropogenic question. But there is no doubt that EPA could improve scientific understanding of atmospheric chemistry through an expanded ozone monitoring network.

In any event, ICAC stands ready to assist EPA in further understanding ozone monitoring methods and technology as it relates to natural background, consistent with the understanding that there is substantial research regarding the health effects of the ozone molecule regardless of its origin as anthropogenic or “natural.”

As the foregoing discussion demonstrates, for more than five decades, ICAC has been at the forefront of developing reliable conventional pollution control technology at costs that are lower than projected. It has done so by working together with industry, EPA and relevant stakeholders. A key to success in this area has been creation of a policy environment that provides ICAC and its customers with a stable planning horizon. ICAC has a long history of working with EPA on a range of regulations and policies, as seen in Attachment A, which lists ICAC comments and white papers written by our members. ICAC members look forward to working with Administrator Pruitt and EPA to achieve similar successes in the days and months ahead.

ATTACHMENT A

ICAC Publications List

WHITE PAPERS AND OTHER DOCUMENTS

- ❑ [ICAC Submits Comments on Updates to EPA Cost Manual Chapters on VOCs \(December 2016\).](#)
- ❑ [White Paper: Dry Sorbent Injection for Acid Gas Control: Process chemistry, waste disposal, and plant operational impacts](#)
- ❑ [ICAC Submits Comments on Quad J Portion of EPA Revisions to Test Methods, Performance Specifications, and Testing Regulations for Air Emission Sources \(80 FR 54146\) \(December 2015\).](#)
- ❑ [ICAC Submits Comments on SNCR Chapter of EPA Cost Manual \(September 2015\).](#)
- ❑ [Guidance Document on Startup and Shutdown Under MATS \(July 2015\).](#)
- ❑ [Process Implementation Guidance for Powdered Sorbents at Electric Generating Units \(February 2015\).](#)
- ❑ [ICAC Submits Comments on Carbon Pollution Emissions Guidelines for Existing Stationary Sources: Electric Utility Generating Units \(December 2014\)](#)
- ❑ [Improving Capture of Mercury Efficiency of WFDGs by Reducing Mercury Reemissions \(June 2014\)](#)
- ❑ [ICAC Submits Comments on Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Generating Units \(May 2014\).](#)
- ❑ [ICAC Submits Comments on MATS Startup and Shutdown \(August 2013\)](#)
- ❑ [White Paper: Guidelines for Specifications & Selection of Data Acquisition & Handling Systems for Continuous Emissions Monitoring Applications \(May 2013\)](#)
- ❑ [White Paper: Guide to FTIR Technology for Compliance Testing, Performance Specification, & Continuous Emissions Monitoring \(CEM\) of Target Gases \(May 2013\)](#)
- ❑ [White Paper: Monitoring of HCl \(January 2013\)](#)
- ❑ [White Paper: Conducting A Successful Mercury Control Demonstration Test At A Coal-fired Power Boiler \(January 2013\)](#)
- ❑ [White Paper: Ammonia Measurement for Combustion Sources \(June 2011\)](#)
- ❑ [White Paper: Selective Catalytic Reduction \(SCR\) for NOx Emissions from Fossil Fuel-Fired Electric Power Plants \(May 2009\)](#)
- ❑ [White Paper: Design and Operation of Fabric Filter and Electrostatic Precipitator Hoppers with High-Carbon Ash \(October 2007\)](#)
- ❑ [White Paper: Options and Incentives to Rebuild/Replace VOC Oxidation Equipment \(June 2003\)](#)
- ❑ [Guidance for Estimating Gas Consumption in RTOs \(July 2002\)](#)
- ❑ [White Paper: Guidance for Sampling of NOx Concentrations for SCR System Control in Gas-Fired Applications \(October 2000\).](#)
- ❑ [White Paper: Selective Non-Catalytic Reduction \(SNCR\) for Controlling NOx Emissions \(February 2008\)](#)
- ❑ [White Paper: Guidance for Sampling of NOx Concentrations for SCR System Control in Coal-Fired Applications \(July 1999\).](#)

- [CEMS and EPA's Any Credible Evidence Rule \(March 1999\)](#)
- [Portable Electrochemical Analyzer Conditional Test Method \(April 1999\)](#)
- [Using VOC Control Technologies to Help Your Bottom-Line \(July 1998\)](#)
- [White Paper: Air Emissions Monitoring for Safe and Efficient Medical Waste Incinerator Operation \(September 1997\)](#)
- [White Paper: NOX Control Installation Timing for Industrial Sources \(December 2006\)](#)
- [Design and Operation of Fabric Filter and Electrostatic Precipitator Hoppers with High Carbon Ash \(October 2007\)\(pdf\)](#)

TECHNICAL GUIDELINES

- [HG-1 Bid Specification and Information Requirements and Bid Evaluation Form for Activated Carbon Injection Systems \(2010\)](#). The document will assist purchasers of activated carbon injection systems compile information necessary to procure meaningful bids from suppliers of activated carbon injection systems. The document includes bid specification information requirements, a bid evaluation and a sample bid specification.
- [PM CEMS -Guidelines for Preparing Bid Specifications and Bid Evaluations for Particulate Matter Continuous Emissions Monitoring Systems\(2008\)](#). Guidelines for specifying and collecting information necessary to solicit bids fo suppliers of PM CEMS as defines in 40CFR Part 60 Appendix B, Performance Specification 11 and Appendix F Procedure 2.
- [CEM-1 Guidelines for Preparation of Bid Specifications and Bid Evaluations for CEMS\(1998\)](#). Guidelines for specifying and collecting information necessary to solicit bids from CEMS suppliers.
- [EM-2 Guidelines for Specification of Calibration Gases for Continuous Emissions Monitoring Systems and Portable Stack Analyzers \(2000\)](#). Guidelines for determining and collecting data necessary to solicit bids from suppliers of calibration gases and related gas handling equipment for use with CEMS and portable stack gas measurement instruments.
- [CEM-2 Guidelines for Preparing Bid Specifications and Bid Evaluations for Continuous Opacity Monitoring Systems \(2004\)](#). Guidelines for specifying and collecting information necessary to solicit bids from COMS suppliers.
- [EM-4 Guidelines and Recommended Practices for Preparing Bid Specifications and Bid Evaluation for Sample Transport Bundle \(2006\)](#) Guidelines for preparing a specification for the solicitation and evaluation of bids for sample transport bundles.
- [EM-3 Guidelines for Specification and Selection of Data Acquisition and Handling Systems for Continuous Emission Monitoring Applications \(rev. 2007\)](#). Guidelines for helping CEMS users to understand the scope of supply that DAHS vendors provide, and provide a road map for satisfactory DAHS procurement.
- [PACE-1 Guidelines For Evaluating and Selecting Portable Analyzers for Combustion Emissions Measurement \(2007\)](#). Guidelines to ease the process of purchasing a portable emissions analyzers and to help customers specify and obtain analyzers to that best meet their needs.
- [G-2 Factors to Consider in Selecting GEC Equipment \(1982\)](#). Worksheet with explanatory text designed to help purchasers of gaseous emission control equipment outline their needs.

- F-5 Types of Fabric Filters (rev. 1991). Descriptions and schematic diagrams of different fabric collector arrangements, with brief explanations of their uses and operation.
- F-6 Baghouse Operation and Maintenance Log for Assessment of Stack Test Results(1994). Log for collecting fabric filter O&M data necessary for determining whether stack test results are valid and representative of expected operations.
- F-7 Fabric Filter Gas Flow Model Studies (1996). Provides information on and establishes design criteria for modeling gas flow in fabric filters.
- EP-1 Terminology for Electrostatic Precipitators (rev. 2000). Definitions of key terms relating to electrostatic precipitators and their operation, with diagrams of precipitators included.
- F-3 Operation and Maintenance of Fabric Collectors (rev. 2002). General guide to start-up, operation, maintenance, and troubleshooting of fabric filters collectors.
- EP-7 Electrostatic Precipitator Gas Flow Model Studies (rev. 2004) Guidelines for modeling gas flows in electrostatic precipitators in order to ensure flow uniformity in the finished unit.
- EP-10W Bid Specification Information Requirements and Bid Evaluations Forms for Wet Electrostatic Precipitators (2008). This publication contains forms and accompanying text for collecting data necessary to solicit bids from vendors for wet electrostatic precipitators, preparing specifications and bid documents, and for collecting the elements of and evaluating the bids received.
- EP-8 Structural Design Criteria for Electrostatic Precipitator Casings (rev. November 1993). Outline listing criteria for the structural design of casings for electrostatic assure precipitators in order to both the structural soundness of the casings and uniformity throughout the industry.
- F-8 Structural Design Criteria for Fabric Filters (2001). Sets minimum criteria for the structural design of fabric filter casings
- SCR-2 Structural Design Guideline for SCR Reactor Structures (2002).

Andover Technology Partners

978-683-9599

Consulting to the Air Pollution Control Industry

Update of the Cost of Compliance with MATS – Ongoing Cost of Controls

White Paper

By

James E. Staudt, Ph.D.

Andover Technology Partners

May 25, 2017

Purpose

The purpose of this effort is to estimate annual operating costs associated with MATS. In effect, what the impact would be in terms of operating costs if MATS was rescinded. These operating costs include:

1. Operating and maintenance costs associated with ACI – this includes the cost of activated carbon as well as any energy used for the systems, waste disposal and maintenance costs.
2. Operating and maintenance costs associated with DSI - this includes the cost of lime or trona as well as any energy used for the systems, waste disposal and maintenance costs.
3. Operating and maintenance costs associated with chemical injection – this would include the costs associated with bromine (or other oxidizing chemicals) as well as chemicals used to control reemission of mercury in wet scrubbers
4. Operating and maintenance costs associated with fabric filters – this will include the costs associated with the energy demand associated with the increased pressure drop across the device, periodic replacement of filter media, and other maintenance or operating labor or materials. It is worth noting that were MATS rescinded, these costs would not go away because the fabric filter cannot be simply “turned off” in the manner that ACI, DSI or the chemical addition can. Rescinding MATS would therefore have no impact on these costs.
5. Operating and maintenance costs associated with monitoring Hg and HCl and increased frequency of PM measurements

Although there were some scrubber and ESP upgrades performed for MATS, these generally do not result in an increase in operating or maintenance costs.

The methodology for this effort will also differ from the methodology used in the past.¹ In that earlier effort Andover Technology Partners (ATP) examined how the United States Environmental Protection Agency (EPA) overestimated the cost of compliance with MATS when they issued the final rule. While EPA provided information about the MW of capacity retrofit in various means, EPA only provided limited detail of the components of the cost. Moreover, EPA’s analysis included costs associated with changes in the fuels used in the generation fleet. As a result, the method used to assess how much EPA overestimated the cost of controls was by necessity using their estimated total cost as a starting point and then backing out various cost components per the actual installations and using the cost methodology used by EPA that is described in the documentation for the integrated planning model.

If the previous method examined cost from a “top-down” approach that started with the total cost estimated by EPA, in this effort the operating costs will be built up from a “bottom up” approach. This is done by looking at the total installations of various technologies and determining the associated operating cost. This approach will not examine any costs associated with changes in the fleet fuel mix that might be attributable to MATS. First, because the cost of natural gas is so much less than the expected cost of natural gas when MATS was promulgated, it is likely that MATS had a very small impact

¹ Declaration of James E. Staudt, Ph.D., CFA, United States Court of Appeals for the District of Columbia Circuit, White Stallion Energy Center, LLC, et al, v United States Environmental Protection Agency, Case No. 12-1100, Argued December 10, 2013, Decided April 15, 2014, Declaration submitted September 24, 2015.

on decisions to increase use of natural gas for power generation. Also, this is a question whose answer is almost indeterminable because many different factors influence fuel switching and plant retirement decisions. Another impact is the effect of retirements. While there were a substantial number of coal retirements during the time period leading up to the MATS compliance dates and even coincident with MATS dates, most of these facilities were uneconomical even without MATS and were destined for retirement.

Also, in examining the impact of MATS versus state rules requiring mercury control it was determined that only those facilities that installed Hg controls in 2014 through 2016 would be regarded as being subject to MATS as opposed to a state rule. Therefore, facilities that installed mercury controls either before or after that period are not included in this estimate.

For the purpose of this effort it will be assumed that all MATS control technology was installed in the years 2014 through 2016. Installations prior to 2014 were likely the result of state regulations, consent decrees, or other requirements. It is possible that some installations during 2014-2016 were in response to requirements other than MATS, such as state regulations; however, it is likely that the large majority of the installations in those years were for MATS compliance. In any event, EIA Form 860 data indicates that most facilities installed technology for MATS compliance from 2014-2016 and very few facilities installed mercury controls in 2013. The results of an analysis of EIA form 860 Environmental Association, EIA form 860 generator data and EIA Form 923 unit generation data are shown in Table 1. The 2016 generation is the 2016 generation associated with the facilities installed with a particular technology in a given year and will be used to help estimate variable operating costs associated with that equipment. In making estimates of future cost it is assumed that all of the associated facilities continue to operate at a level similar to that of 2016, except for those where announcements to retire by 2018 were made.

Operating and Maintenance Costs Associated with ACI installed for MATS Compliance

Operating costs for ACI include variable operating costs associated with sorbent consumption (VOMR), waste disposal, if needed (VOMW), power consumption (VOMP) and fixed operating and maintenance costs (FOM). Variable operating costs for sorbent consumption for any application will vary based upon the conditions. Table 2 shows estimated VOMR for activated carbon for a range of applications.

The costs therefore range from under 0.10 mill/kWh to under 1.0 mill/kWh. The most costly conditions are those where there is SO₃ conditioning or high sulfur coal. These, fortunately, are not the most common situations. The more common situations utilize lower treatment rates, resulting in costs on the order of 0.60 mills/kWh or less.

Variable operating costs will also include disposal costs for waste. Activated carbon will increase the amount of fly ash that must be disposed of. Generally, it does not adversely impact fly ash sales because suppliers have developed "concrete friendly" carbons and are also able to utilize much lower treatment rates than in the past. Trends have been for increases in fly ash utilization, despite the increased use of activated carbon. In fact, in 2015 52% of coal combustion products (CCPs) were

reutilized.² If fly ash is sold there is no impact on the cost of waste disposal. If fly ash is disposed of it will increase the cost of disposal in proportion to the carbon used. If disposal cost is \$50/ton (\$0.025/lb) and carbon costs around \$1/lb, disposal cost is roughly 2.5% of the cost of purchasing the carbon. In light of the increased utilization of fly ash that will mitigate the likelihood of disposal, this assumption is a conservative one.

Table 1. Installation of control technologies associated with MATS from 2014-2016 and associated generation in 2016. Developed from EIA data – Forms 860 and 923

| Year | Tech | number | Capacity (MW) | 2016 Generation (MWh) | Capital Cost (\$1000) |
|--|------|--------|---------------|-----------------------|-----------------------|
| 2014 | ACI | 21 | 8,470 | 34,337,506 | 222,988 |
| 2015 | ACI | 88 | 39,608 | 183,651,033 | 496,218 |
| 2016 | ACI | 88 | 38,256 | 186,905,590 | 322,191 |
| Total | ACI | 197 | 86,333 | 404,894,129 | 1,041,397 |
| 2014 | LIJ | 1 | 641 | 3,384,917 | 2,307 |
| 2015 | LIJ | 2 | 1,398 | 8,369,775 | 1,646 |
| 2016 | LIJ | 5 | 2,065 | 9,400,899 | 17,000 |
| Total | LIJ | 8 | 4,104 | 21,155,591 | 20,953 |
| 2014 | DSI | 1 | 477 | 2,469,155 | 81,240 |
| 2015 | DSI | 9 | 2,918 | 11,504,817 | 179,155 |
| 2016 | DSI | 14 | 6,176 | 24,552,813 | 94,201 |
| Total | DSI | 24 | 9,571 | 38,526,785 | 354,596 |
| 2014 | OT | 1 | 151 | 62,319 | 11,800 |
| 2015 | OT | 18 | 5,983 | 32,928,191 | 26,227 |
| 2016 | OT | 12 | 3,648 | 8,752,470 | 303,387 |
| Total | OT | 31 | 9,782 | 41,742,980 | 341,414 |
| 2014 | BP | 9 | 4,614 | 25,387,390 | 402,076 |
| 2015 | BP | 11 | 4,539 | 21,010,362 | 495,120 |
| 2016 | BP | 11 | 6,833 | 32,147,754 | 420,248 |
| Total | BP | 31 | 15,986 | 78,545,506 | 1,317,444 |
| ACI = activated carbon injection LIJ = Lime injection DSI = Dry sorbent injection OT = Other BP = Pulse jet baghouse | | | | | |

² American Coal Ash Association, “Coal Ash Recycling Reaches 52 Percent As Production and Use Trends Shift”, October 12, 2016, <https://www.acaa-usa.org/Portals/9/Files/PDFs/News-Release-Coal-Ash-Production-and-Use-2015.pdf>

Table 2. The variable operating cost of sorbent for current, state of the art, commercial carbons.³

| Coal-FiredSite | Product | AQCS | Fuel | DSI | FGC | % Removal Hg | mill/Kwh |
|----------------|-----------------------|---------------|----------------------|---------------|------------------------|--------------|----------|
| 1 | DARCO® Hg-LH EXTRA SP | SCR/FF | Low Chlorine Subbit. | None | None | 94 | 0.086 |
| 2 | DARCO® Hg-LH EXTRA SP | CS-ESP | Local W.Subbit | None | None | 80 | 0.222 |
| 3 | DARCO® Hg-LH EXTRA SP | CS-ESP | Local W.Subbit | None | None | 80 | 0.244 |
| 4 | DARCO® Hg-LH EXTRA SP | CS-ESP | Low Chlorine Subbit. | None | None | 87 | 0.328 |
| 5 | DARCO® Hg-LH EXTRA TR | CS-ESP/wFGD | High Sulfur Bit. | Calcium-based | None | 82 | 0.375 |
| 6 | DARCO® Hg-LH EXTRA TR | CS-ESP | PRB/Bit. Blend | Sodium-based | None | 88 | 0.663 |
| 7 | DARCO® Hg EXTRA | CS-ESP | Low Chlorine Subbit. | None | SO ₃ (6ppm) | 90 | 0.789 |
| 8 | DARCO® Hg-LH EXTRA SR | CS-ESP | PRB | None | SO ₃ (7ppm) | 90 | 0.872 |
| 9 | DARCO® Hg EXTRA SR | SNCR/ESP/wFGD | High Sulfur Bit. | None | None | 96 | 0.980 |

Other variable operating costs include energy, estimated as about \$0.01/MWh of generation from the Sargent & Lundy study on mercury control.⁴

Fixed operating costs for operation and maintenance are estimated at 1.4% of capital cost, including overhead, per the Sargent & Lundy study.

Using these factors and the information in Table 1, the costs for operating ACI systems is estimated to be:

Table 3. Operating costs for ACI systems installed for MATS compliance

| | | | | |
|-----------------|---------------|------------|--------------|------------------------|
| VOMR | \$242,936,000 | FOM | \$14,580,000 | Total VOM + FOM |
| VOMW | \$6,073,000 | | | |
| VOMP | \$4,049,000 | | | |
| VOMTotal | \$253,058,000 | | \$14,580,000 | \$267,638,000 |
| Cost in \$/MWh | | | | \$0.66 |

Operating and Maintenance Costs for DSI Systems installed for MATS compliance

EIA Form 860 shows both lime injection systems (LIJ) and DSI systems. DSI systems potentially include trona as well as lime injection systems. The average cost of the LIJ systems in EIA Form 860 are significantly lower than those of the DSI systems (\$5/kW compared to \$37/kW), suggesting that the LIJ systems were primarily used for SO₃ control while many of the DSI systems were for HCl control.

VOMR is estimated by assuming roughly 2 lb of lime reagent per lb of total acid gas (using SO₂ since it is usually present in much larger quantities than HCl), an average 2lb SO₂/MMBtu coal, average heat rate

³ Fessenden, J., Satterfield, J., "Cost Effective Reduction of Mercury Using Powder Activated Carbon Injection", March 2, 2017

⁴ Sargent & Lundy, "IPM Model – Updates to Cost and Performance for APC Technologies Mercury Control Cost Development Methodology Final", March 2013, Project 12847-002, Systems Research and Applications Corporation

of 10,500 Btu/kWh, and a cost of activated lime equal to \$125/ton.⁵ It should be noted that for units that fire coal from the Powder River Basin (PRB), the lime consumption would be much less and in many cases no lime would be necessary to be added – the DSI system is added primarily as a precaution.

Variable operating costs will also include disposal costs for waste. DSI will increase the amount of fly ash that must be disposed of. Generally, it does not adversely impact fly ash sales because the most commonly used reagent is lime, which will generally improve fly ash marketability. If fly ash is disposed of, it will increase the cost of disposal in proportion to the lime used. Disposal cost is estimated at \$50/ton. Since 52% or more of the industry’s coal ash is recycled, it is reasonable to assume that 48% of the facilities need to dispose of waste.

Other variable operating costs include energy, estimated as about \$0.39/MWh from the Sargent & Lundy study on DSI.⁶

Fixed operating costs for operation and maintenance are estimated at 1.4% of capital cost, including overhead, per the Sargent & Lundy study. The Sargent & Lundy study includes two additional operators for a DSI system. This is not correct. DSI systems are simple systems that generally do not require additional operators.

Using these factors, the costs for operating DSI and LIJ systems is estimated to be:

Table 3. Operating costs for DSI and LIJ systems installed for MATS compliance

| | | | | |
|--|---------------|------------|-------------|------------------------|
| VOMR | \$78,333,000 | FOM | \$5,257,000 | Total VOM + FOM |
| VOMW | \$32,228,000* | | | |
| VOMP | \$23,276,000 | | | |
| VOMTotal | \$133,837,000 | | \$5,257,000 | \$139,094,000 |
| Total cost \$/MWh | | | | \$2.33 |
| * assumes 48% of facilities dispose of waste | | | | |

This is a very conservatively high estimate of cost because in many cases not as much reagent is needed because sulfur and HCl content may be low, as in the case of PRB fuel. Moreover, many of these systems are likely to be primarily for SO₃ control rather than HCl control and therefore use much lower reagent treatment rates. Also, the additional calcium may actually make the fly ash more attractive for beneficial reuse, lowering the waste disposal costs.

⁵ Treatment rate from: Fitzgerald, H., “Hydrated Lime DSI - Solution for Acid Gas Control (SO₃, HCl, and HF)”, MARAMA /ICAC SO₂/HCl CONTROL TECHNOLOGIES WEBINAR, July 19, 2012
Also, USGS Minerals Yearbook, shows 2014 cost of lime of \$122/metric ton, or about \$110 per short ton. \$125/short ton is than assumed in this evaluation.

⁶ Sargent & Lundy, “IPM Model – Updates to Cost and Performance for APC Technologies, Dry Sorbent Injection for SO₂ Control Cost Development Methodology – Final”, March 2013, Project 12847-002, Systems Research and Applications Corporation

Operating and Maintenance Costs for Other technologies installed for MATS compliance

EIA Form 860 includes a category of “other” for other technologies. Most are listed as used for mercury control. Because of the capital cost of many of these technologies (averaging \$35/kW) this may include chemical addition, but likely also includes ESP and FGD upgrades. ESP and FGD upgrades do not entail any additional operating or maintenance costs. Chemical additives do. Hg oxidation and scrubber additives for mercury control were estimated in the 2015 ICAC Market forecast⁷ to be in the range of \$80-\$100 million for the years 2018-2019. For the purpose of this work, we will assume a cost of \$90 million per year. Energy used for chemical addition systems are minimal.

While the total capital cost of “OT” items is \$342 million, most of that cost is likely to be associated with technologies other than chemical addition (scrubber or ESP upgrades, perhaps). In any event, FOM cost will be assumed to be 1.4% of total capital cost, similar to ACI or DSI. The costs are shown in Table 4.

Table 4. Operating and Maintenance costs for Chemical Addition

| | |
|--------|--------------|
| VOM | \$90,000,000 |
| FOM | \$4,780,000 |
| TOTAL | \$94,780,000 |
| \$/MWh | \$2.19 |

Operating and Maintenance Costs for Baghouses installed for MATS compliance

There are no reagents used with baghouses (aka. “fabric filters”). Baghouses require some labor from operators and also require power and periodic replacement of filter media. Total VOM and FOM are estimated as \$0.42/MWh and \$0.68/kW-year, respectively.⁸ Costs are shown in Table 5. It is important to recognize, however, that if MATS is rescinded, these costs will not go away because a fabric filter, unlike the other technologies, cannot simply be turned off without also turning off the rest of the associated boiler.

Table 5. Operating and Maintenance costs for Fabric Filters

| | |
|--------|--------------|
| VOM | \$32,989,000 |
| FOM | \$10,870,000 |
| TOTAL | \$43,859,000 |
| \$/MWh | \$0.56 |

⁷ Institute of Clean Air Companies, 2015 Annual Market Study, pp 19-20. Available at www.icac.com

⁸ Sargent & Lundy, “IPM Model – Updates to Cost and Performance for APC Technologies, Particulate Control Cost Development Methodology – Final”, March 2013, Project 12847-002, Systems Research and Applications Corporation, pg 8

Operating and Maintenance Costs of Hg CEMS

Operating costs of Hg CEMS include the labor and materials for operating and maintaining the equipment as well as the cost of Relative Accuracy Test Audits and other compliance requirements of the CEMS. This was estimated as roughly \$100,000 per year in a 2010 NESCAUM Report. At the end of 2016 there were 664 coal units in the United States operating that generated 1,158,929,439 MWh of electricity. Of them, 233 units among 84 plants had common chimneys. The total number of common chimneys was 111 for the 233 units. Therefore, there are a total of 542 chimneys in the US coal fleet that must be monitored. This means that the total ongoing cost of monitoring is roughly \$54 million across the coal fleet for a total cost of \$0.05/MWh. This cost estimate likely overestimates the cost because many facilities already had requirements imposed upon them by state Hg control regulations.

Operating and Maintenance Costs of HCl monitoring

Scrubbed units for the most part can demonstrate compliance with the HCl requirements of MATS maintaining adequately low SO₂ emission rates. Therefore, for most scrubbed units there is no additional monitoring need for HCl. For units that are not equipped with scrubbers, stack testing of HCl is necessary. Based upon a sort of 2016 AMPD data, at the end of 2016 there were 266 unscrubbed coal utility or small power producer units that generated 252,190,593 MWh of electricity. Of these, 165 units had individual chimneys and 101 units had common chimneys. Those 101 units had among them 39 common chimneys, resulting in a total of 204 chimneys for all of the unscrubbed units.

It is assumed that the cost of monitoring HCl is similar to that of Hg at \$100,000/year per chimney. Therefore, the ongoing operating cost of monitoring HCl emissions is \$20.4 million in total. Dividing that by the 2016 generation for those units results in \$0.08/MWh

Operating costs associated with increased PM measurement frequency

For those facilities that do not already have a PM CEMS due to Consent Decree or other requirement, facilities will need to increase PM measurement frequency to quarterly. Some facilities may already have quarterly measurement requirements that are imposed by the state. Others may only have annual requirements. It is not possible to determine the incremental cost of increased PM measurement due to MATS frequency industrywide because of the use of PM CEMS under Consent Decrees and other factors. However, like Hg and HCl measurement costs, it will be substantially less than the cost of controls and likely less than the incremental cost of HCl measurement and reporting.

Total operating costs for all MATS technologies

Total operating costs for all MATS technologies for all 664 coal units, including fabric filters is as shown in Table 6 and totals roughly \$620 million. If fabric filter operating costs are removed, the total operating costs are roughly \$576 million.

Table 6. Total Operating Costs for MATS technologies.

| | |
|----------------|---------------|
| ACI | \$267,638,000 |
| DSI | \$139,094,000 |
| OT | \$94,780,000 |
| FF | \$43,859,000 |
| Hg CEMS | \$54,200,000 |
| HCl monitoring | \$20,400,000 |
| Total | \$619,971,000 |

The total cost (including FF cost) divided by total 2016 generation for all 664 units results in a cost of \$0.53/MWh. If FF costs are excluded, the cost per MWh is \$0.50/MWh. It is reasonable to exclude FF costs because a fabric filter (or, baghouse) cannot be turned off without turning off the power plant. Therefore these costs would not go away if MATS were rescinded or relaxed.



THE INSTITUTE OF CLEAN AIR COMPANIES (ICAC)
INTERNATIONAL CONVENTIONAL
POLLUTANTS DIVISION

Issue Brief for
United States Environmental Protection Agency
Administrator E. Scott Pruitt



EXECUTIVE SUMMARY

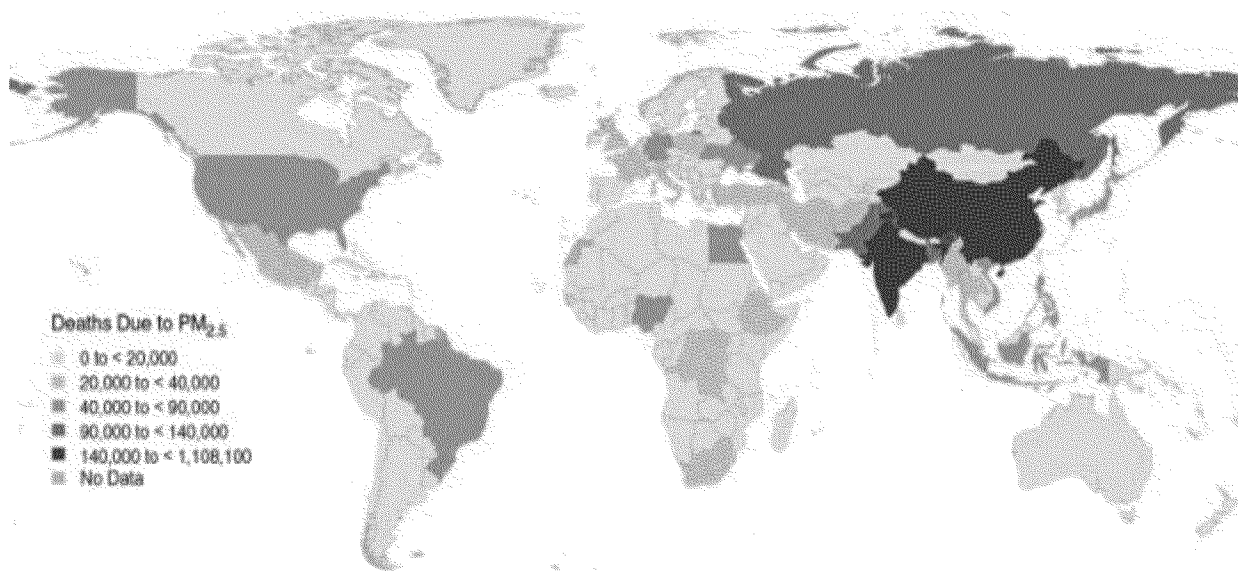
Global trade in environmental technologies is calculated to be worth approximately one trillion dollars per year and the U.S. share of that trade is worth more than 200 billion dollars. The worldwide air pollution control market is worth approximately 60 billion dollars annually and the U.S. share of that is worth approximately 20 billion dollars annually. There is an enormous opportunity for the U.S., as a world leader in air pollution control, to export such technologies around the globe. ICAC is working with EPA and the Department of Commerce on numerous trade and export related activities, including the joint EPA/Commerce Environmental Solutions Toolkit, the Environmental Technologies Trade Advisory Committee (ETTAC), Trade Missions, Market Reports and negotiations related to environmental goods. ICAC encourages EPA leadership to participate in and support these activities.

1. INTRODUCTION

Global trade in environmental technologies, materials and services is estimated to be worth almost a trillion dollars annually. In 2015, the United States exported environmental technologies, materials and services worth \$238 billion, and these types of exports have been growing at a rate of about six percent per year. This resulted in a trade surplus for the environmental industries sector of \$26.9 billion in 2015. The U.S. environmental industries sector supported over 1.6 million jobs and generated over \$320 billion in revenue. Although these figures represent combined, air, water, waste and other technologies, a substantial element in all of these figures is the contribution of the air pollution control industry, and globally, that market is expected to grow in the years ahead. The global market for air pollution control equipment reached nearly \$56.6 billion and \$61 billion in 2013 and 2014, respectively. This market is expected to grow at a compound annual growth rate (CAGR) of 5.2% to \$78.4 billion for the period 2014-2019. According to the International Trade Administration's Top Markets Report, U.S. industry revenues for air pollution control in 2015 totaled \$20.1 billion, including equipment, instruments and related services.

For more than 50 years, the United States has led the way in clean air pollution control technology, resulting in perhaps the most successful clean air program anywhere in the world. This program has created many skilled jobs here in the United States. As the map below shows, there is an enormous opportunity that exists for us to sell pollution control in countries like India and China, which have air pollution problems that affect billions of people at dangerously high pollution levels.

Figure 1. Number of Deaths Attributed to Fine Particulate Matter
(<https://www.stateofglobalair.org/>)



EPA, the U.S. Department of Commerce (DOC), and the U.S. Department of State can play a key role in protecting and expanding this market. ICAC has worked with and continues to work with the EPA Office of International Affairs, and with DOC and the Department of State to assess current markets, and develop new market opportunities. We have also worked to promote trade and information exchange and to remove barriers to trade that exist in the environmental area.

The following discussion highlights a few of these key efforts and the ongoing international work of ICAC, DOC and the Department of State in the environmental technologies area. We include a few recommendations for additional areas that ICAC, EPA and DOC could collaborate.

2. EPA/DEPARTMENT OF COMMERCE/ICAC INTERNATIONAL ACTIVITIES AND ISSUES

2.1 THE U.S. ENVIRONMENTAL SOLUTIONS TOOLKIT

EPA and the Department of Commerce International Trade Administration have jointly developed the U.S. Environmental Solutions Toolkit. The Toolkit is an interactive online guide that connects U.S. providers of environmental technologies and services to potential clients around the world. The Toolkit was created in collaboration with private entities like ICAC. As noted by the then Undersecretary of Commerce Francisco Sanchez, “This product was the genesis of cooperation between the U.S. government and the private sector and will foster export opportunities and job creation in the U.S. environmental industry, while advancing environmental protection goals around the world.”

The Toolkit allows users to identify EPA solutions for environmental issues, links those solutions with appropriate technology, and allows the user to identify and connect with suppliers of those technologies. It provides “one-stop” shopping for such foreign buyers of pollution control products.

An updated Toolkit is being released and additional opportunities for private sector input are being explored. ICAC is actively involved in these efforts with EPA and DOC. ICAC would like to work with EPA and DOC to explore ways in which the Toolkit could gain greater prominence worldwide so that it would become the “go to” tool for foreign business seeking pollution control. Some consideration should be given to marketing channels for promoting the tool to target users. Other activities could include ICAC working with EPA and other federal agencies to assess the state of pollution control efforts in other countries and, based on that assessment, helping to promote the Toolkit as a key resource for foreign entities seeking to purchase and install pollution controls. A key aspect of that would be further work and cooperation with EPA and DOC on the Top Markets Report, as described below.

2.2 TOP MARKETS REPORT

A useful tool for assessing markets is the Top Markets Report on Environmental Technologies. DOC has recently updated the report for 2017. The report covers 2017, but also uses data and inputs from prior years as well. The Top Markets report identifies and ranks more than fifty export markets where focused government resources will have the

largest impact in increasing commercial opportunities for U.S. companies. The Top Markets report uses three key criteria for making this assessment: the first is to look for markets that are large and growing, the second is to look for markets that have a clear and increasing need for imported technology and services and the third is to check whether U.S. exports are lower than predicted, which may indicate the presence of policy and trade barriers. The report includes 10 case studies for specific countries and three regional supplements. A link to the Top Market Report is here: <http://www.trade.gov/topmarkets/environmental-tech.asp>

As DOC updates this report in future years, ICAC will continue to work with them to ensure that it includes the latest information and continues to be a very useful tool for all in the pollution control technology area. The Top Markets Report assesses several countries, and the inclusion of additional information regarding the regulatory programs in these and other countries could be very useful. We encourage additional resources be devoted to this area and believe EPA can play an important role. In particular, we would hope that EPA could provide assistance in better understanding the regulatory situation in both the Top Market countries and other countries, which will be helpful both environmentally and for businesses seeking to sell into such markets.

2.3 THE ENVIRONMENTAL TECHNOLOGIES TRADE ADVISORY COMMITTEE

Created by Congress in 1994 under the “Jobs Through Trade Expansion Act”, the Environmental Technologies Trade Advisory Committee (ETTAC) is a federally-established advisory committee composed of industry professionals whose purpose is to advise the Environmental Trade Working Group, through the Secretary of Commerce, on the policies and procedures of the U.S. government that affect environmental technology exports. ICAC President Michael Corvese is a member of the ETTAC, along with a number of other individuals representing ICAC member companies.

The ETTAC is in the process of making recommendations to Secretary Ross. These will include recommendations regarding both NAFTA and, as discussed below, pursuit of environmental goods agreement(s). We endorse these recommendations and encourage Administrator Pruitt to consider them as well. EPA is also closely involved in the ETTAC, with staff from the EPA Office of International and Tribal Affairs helping ICAC and the DOC assess and pursue export opportunities.

2.4 ENVIRONMENTAL GOODS AGREEMENT (EGA) NEGOTIATIONS

Since 2014, the United States and other countries have been exploring the idea of an environmental goods agreement (EGA), which would equalize the tariff structure for

environmental goods. U.S. tariffs on environmental goods are already low; however, other countries charge tariffs as high as 50 percent on these goods. By eliminating tariffs that other countries impose on environmental goods, we can help level the playing field for U.S. manufacturers and workers – supporting good manufacturing jobs here in the United States.

The negotiations on the EGA included the United States, Australia, Canada, China, Costa Rica, the European Union, Hong Kong, Iceland, Israel, Japan, Korea, New Zealand, Norway, Singapore, Switzerland, Chinese Taipei and Turkey. These countries together account for nearly 90% of global exports in environmental goods.

Leaders of the Asia-Pacific Economic Cooperation (APEC) agreed to reduce tariffs on a list of 54 environmental goods by the end of 2015. Further progress could occur by taking the next step of eliminating tariffs on these 54 goods and expanding product coverage to include additional environmental technologies. The technologies on this list include air pollution control technologies such as wet scrubbers and NOx controls and other products made by ICAC members. Also included on the list are numerous water and wastewater treatment technologies made by ICAC member companies (and other U.S. companies), that will be increasingly in demand worldwide. Some countries apply tariffs as high as 26% on environmental technologies, which play an essential role in reducing harmful emissions and improving public health in cities around the world. Another type of technology that is included would be air and water quality monitors, which are essential for companies and municipalities in meeting environmental performance standards, as well as measuring the energy and water consumption of households and organizations. Tariffs on these products can be as high as 18%.

ICAC would encourage this administration to see if tariffs on these products could be reduced, either in the context of continued negotiations on the EGA or perhaps in the context of an appropriate bi-lateral negotiation, with key countries.

2.5 NAFTA

The administration has announced its intent to renegotiate the North American Free Trade Agreement (NAFTA). ICAC is working with the ETTAC to raise key NAFTA related issues with Secretary Ross. These issues include incorporation of an environment chapter in the core agreement that would include enforceable environmental provisions binding on all countries and support for cooperative efforts to address non-tariff barriers in environmental goods. Another issue that NAFTA should address is intellectual property protection, which is key for ICAC members. We would encourage EPA to assist USTR and the relevant Interagency Working Group in developing and negotiating these provisions so that trade of environmental goods within North America takes place under a more equitable agreement. ICAC would appreciate the opportunity to work with EPA and the DOC on these issues.

3. LOOKING FORWARD

At a recent meeting of the ETTAC on July 18, 2017, DOC Deputy Chief of Staff Israel Hernandez indicated that he would consider a high-level trade mission for the environmental technologies sector. ICAC believes this would be a very useful step forward in promoting exports of U.S. technologies and would encourage Administrator Pruitt to consider participation in such an event along with Secretary Ross and perhaps Secretary Tillerson.

At the same ETTAC meeting, DOC Deputy Assistant Secretary Ian Steff offered to meet with members of ETTAC to discuss their issues and concerns. ICAC and other members of the air pollution control industry plan on meeting with Mr. Steff in the near future. We would welcome a similar meeting with appropriate EPA political leaders on the international front in order to facilitate additional coordination and exchange perspectives.

ICAC is in the process of working with the United States Trade and Development Agency (USTDA) to develop a "Reverse Trade Mission" (RTM) for Worldwide Coal Power Emissions Monitoring and Control. USTDA's goal is to advance U.S. commercial interests and economic development in developing and middle-income countries. USTDA links U.S. companies with foreign governments and businesses. In the RTM, USTDA will fund a trip for regulators and buyers to come to the U.S. and meet with American businesses and tour relevant facilities. In the planned RTM, up to 20 regulators and buyers will be brought to the U.S. and visit up to three cities and likely attend a major convention or trade fair in the air pollution control area. Countries we are considering would include India, Vietnam, Indonesia, Chile, and Columbia among others. We should also look at both the European continent, particularly Eastern Europe and Africa.

ICAC would request that EPA liaison with USTDA and others with a view toward possible high-level participation in the Coal-Fired Power Emissions RTM, as well as any other RTMs we can develop in this area.

Finally, we would note that the proposed administration budget would defund key activities within the EPA Office of International and Tribal Affairs that are critical to the work of enhancing export opportunities for ICAC members in the air pollution control area. Instead of defunding these activities, we would request that Administrator Pruitt and his staff consider ways in which such funding could be maintained and then used to benefit American businesses in order to stimulate our economy and create jobs, while also furthering environmental protection goals.

ICAC appreciates the interest of Administrator Pruitt in this area and is happy to offer any assistance it can provide regarding international air pollution control efforts. We look forward to working with you to help address America's trade imbalance while also helping to protect the worldwide environment.